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The standard of purity for the new water supply of Jersey City, for which proposals may be asked soon, as noted in our issue of Jan. 24, is as follows; the maximum allowable quantities being parts per 100,000, by weight, and having been laid down by Prof. Peter T. Austen, of Brooklyn:

	Maximum allowable quantities.
Solid matter	17.0000
Total organic matter (potassium permanganate (reduced)	0.8000
Earthy bases	8.0000
Chlorine in combination	0.8500
Sulphates	10.0000
Free ammonia	0.0050
Albuminoid ammonia	0.0150
Nitric acid (nitrates)	0.2000
Nitrous acid (nitrates)	None.

The water must be transparent, free from odor, turbidity, alkaline, or acid tastes, and will be limited to a 5° French standard of hardness. These restrictions apply equally to a supply from new sources or to water from the present source, the Passaic River, after filtration, but from new sources no supply will be considered which is not naturally pure and wholesome or which requires filtration or other purification.

The Government timber tests have been progressing during the past year more rapidly than heretofor and tests are now being made at the rate of about 1,500 per month. A large quarto bulletin of several hundred pages is soon to be issued, as a sort of final report on the strength of the four leading varieties of Southern pine. This bulletin will also include the results of investigations as to the best methods of seasoning lumber, and some special investigations on the influence of moisture in affecting the strength of timber. There appears to be some danger that the work may be again interrupted for lack of funds. Thus far this work has been provided for from the appropriation for the Division of Forestry, in the annual Agricultural Department bills. The tests have usually been suspended in the latter part of each fiscal year from the failure of these appropriations, and this will again be the case, unless a special bill is passed for carrying on the work. Such a bill, appropriating $40,000 especially for this work, was passed by the Senate in June last, and was later reported by the Agricultural Committee of the House, and its passage was unanimously recommended. This was in the closing days of the first session of this Congress. It now only remains for the Chairman of the Agricultural Committee of the House to call up this bill and ask for its passage, as it is well known that the House is favorable to the continuance of these investigations. If this is not done before the close of this session (March 4), the work will have to be begun over again, as this is the last session of the present Congress. The Chairman of the Agricultural Committee of the House is Hon. W. H. Hatch, of Missouri. Persons interested in the carrying on of these experiments could probably aid in the passage of this bill by writing to their Congressmen requesting them to try and have the bills called up and passed. Letters addressed directly to Mr. Hatch would probably also be helpful.

Concrete and iron arches on the Melan system, representing different dimensions of floor arches, were built in this city for test purposes in October last, as noted in our issues of Oct. 25 and Nov. 29, and the tests of these arches were commenced Jan. 25, three months after construction. The first tests were of a 3 × 3-in. T-iron and a 4-in. I-beam rib, spanning between the floor beams, but not bedded in concrete. The former carried a maximum load of 15,000 lbs., without any buckling, and the latter carried 14,500 lbs. when it deflected laterally. A 10-in. flat, hollow tile floor of 6-ft. span broke at 10,500 lbs., or 800 lbs. per sq. ft., while a similar floor of arch form, with 6-in. tile, having the same span, cracked at 20,500 lbs., or 1,600 lbs. per sq. in. Both tile arches had concrete filled in over the haunches, and the latter resembled the arch shown in our issue of Oct. 25, but without the portions below the lower curved web, and without the deep haunch blocks, while the openings were of approximately square section. The first concrete arch tested was 3 ins. thick, 6 ft. span, and the load was applied over the middle T-iron rib, which was prevented from lateral buckling by the concrete; at 40,000 lbs. one of the floor beam tiebars broke, and one of the concrete abutments cracked from the lateral pressure, and the pressure ran down to 30,000 lbs., the arch finally cracking at haunches and crown at 35,000 lbs. The next arch was 4 ins. thick, and the load was applied on the arch itself, between the 4-in. I-beams, and the first crack appeared at 35,000 lbs., with 0.08-in. deflection, while at 54,600 lbs., with a deflection of 0.42 in., one of the clamps of the testing machine broke, and the rest of the tests were postponed. After the pressure had thus been relieved, the deflection was reduced to 0.21 in. The tests were made by Mr. Geo. Hill, Assoc. M. Am. Soc. C. E., for Mr. F. von Emperger, C. E., who represents the Melan system in this country. In a later issue we shall give a fuller account of these tests.

According to the official figures just made public, 41,391,199 tons of anthracite coal were marketed in 1894, though probably from 5,000,000 to 7,000,000 tons more were mined. This is less than the 43,089,533 tons marketed in 1893, and is also exceeded by the 41,892,300 tons of 1892, but exceeds the output of any year previous to 1892. The report gives the total of anthracite coal mined since 1820 to 1893, inclusive, as 868,697,189 tons. About 84% of this production is consumed east of the Allegheny Mountains and north of the Potomac. Pennsylvania, New York and New Jersey consume about 33,000,000 tons annually; the West, 9,000,000 tons, and 5,000,000 tons are consumed at the mines and at other points. While the last three years have been the greatest years of tonnage and consumption, prices have fallen off owing to over-production. While the circular prices for 1893 were higher than those of 1888, the actual prices were very irregular and coal has been sold at $1.00 per ton less than the circular rates, down to $3.20 for stove coal at New York. The mine prices for 1894 were—for broken coal, $2.25; egg, $2.40; stove, $2.65; chestnut, $2.50. To this must be added the freight, ranging from $1.70 to $1.80 per ton. The average value at the mines of all anthracite coal produced was $1.79 per ton in 1891; $1.92, in 1892, and $1.57, in 1893.

The most serious railway accident of the week, and the most serious that we have had to report for some time, was the derailment on Jan. 28 of a northbound fast passenger train on the Terre Haute & Indianapolis R. R. (Vandalia Line) at Coatsville, Ind., in which two persons were killed and about 30 injured, some very severely. The train is said to have been running at high speed round a curve when the rails spread, but it is also said that the private car of Mr. McKeen, President of the road, which was at the rear of the train, jumped the track and was followed by the parlor car and day car, all of which went over the embankment. The smoking car left the track, but did not go over the bank. The two rear cars caught fire, but the flames were soon extinguished.

A collision of electric cars on a suburban line from Wilkes Barre, Pa., to Nanticoke occurred Jan. 26, owing to the cars being run "wild" in consequence of the snowstorm preventing them from keeping schedule time. Both cars were running at high speed. One man was killed and nine persons were injured, some fatally.

A boiler in the engine house of the Johnson-Brinkman grain elevator at Rosedale, Kan., exploded Jan. 24, wrecking the building and damaging the machinery.—A boiler explosion in the main building of Henney's brewery, Mendota, Ill., Jan. 25, resulted in the killing of seven men and injuries to six more, while the five-story building collapsed and fell in ruins.

Several accidents have occurred on the Cicero & Proviso electric railway, Chicago, and it is said that the police records, which are incomplete, show that 6 people have been killed and 13 injured (some seriously) since August, 1894. In addition, four horses have been killed, and many horses injured and wagons smashed. The accidents occur mainly on Madison and Lake Sts., and are said to be largely due to the drivers of wagons persisting in driving on the car tracks although the streets are well paved.

A leak was discovered on Jan. 26 in the 4-ft. steel supply main of the Newark water-works. It occurred at a point near Little Falls, N. J., where the main crosses the Passaic River on a bridge. According to a statement furnished us at the office of the East Jersey Water Co., which built the supply main, retains an interest in it and must keep it in repair for a limited number of years, the leak was caused by the settling of the earth beneath the pipe just where the latter rises up onto the masonry abutment of the bridge. This caused a sag in the pipe, which in turn appears to have torn out the rivets in a joint which came at an angle just over the edge of the abutment, opening the joint somewhat on the upper half of the pipe. It was estimated that water escaped from the main at the rate of 500,000 gallons in 24 hours. Fortunately, it is stated, the water discharged itself into the river without damage to the embankment. To prevent loading the bridge with ice from the spray accompanying the leak, and to avert damage of any sort, a flume was built to carry the water directly into the river. The main was designed to carry 50,000,000 gallons a day, much above the present demands upon it, so the water had been allowed to waste up to Tuesday while waiting for suitable weather to make repairs. The city of Newark has sufficient storage capacity to carry it over the necessary period for repairs to the pipe, but the smaller places supplied, Montclair, Bloomfield and West Orange, might be inconvenienced if the water was shut off many hours.

The sinking of the steamer "Elbe," of the North German Lloyds Line, after collision with another vessel in the North Sea, was reported Jan. 30. The steamer was on her way from Bremen to New York, and over 300 lives are said to have been lost, only 20 persons being saved.

Some of the piers of the Central viaduct, in Cleveland, O., are said to be sinking agan. These piers were raised 10 ins. last year. Borings made by Mr. Farley, Director of Public Works, are said to show that while the piers are founded on clay, 14 ft. below the surface, a stratum of soft mud, 25 ft. deep, is now found under the clay. It is proposed to pump liquid cement into this mud, and thus solidify it sufficiently to support the weight imposed.

The Nicaragua Canal bill has passed the U. S. Senate by a vote of 31 to 21. Though amended, the bill is not materially changed. It provides for government control and guarantees $70,000,000 in 5% bonds—$30,000,000 more bonds may be issued without a guarantee; but it is said that there is little or no prospect of the bill passing the House as now organized. The United States government, in consideration of the guarantee, is to secure $70,000,000 in stock of the Maritime Canal Company; $6,000,000 is to go to Nicaragua, $1,500,000 to Costa Rica, and the remaining $22,500,000 is to be used in extinguishing former issues of stock and for the construction of the canal. Ten of the 15 directors of the company are to be appointed by the President of the United States, with the advice and consent of the Senate.

The Carnegie Steel Co., says rumor, is investigating the manufacture of heavy guns, with the possible intention of in this way further utilizing its heavy plant at Homestead. The Bethlehem Iron Co. is already engaged in this department of manufacture, and it is thought that with the present resources of the Carnegie Co. a comparatively small expenditure would add the necessary additional plant. It is proposed to compete with foreign makers and orders would be solicited from France and Russia.

RUSTLESS COATINGS FOR IRON AND STEEL.

The protection of iron and steel from corrosion is one of the most serious problems connected with engineering construction. In our issue of July 19, 1894, we abstracted a paper on "Rustless Coatings for Iron and Steel," presented at the Montreal meeting of the American Society of Mechanical Engineers, by Mr. M. P. Wood, M. Am. Soc. M. E. At the recent New York meeting of this society, Mr. Wood read a paper supplementary to the above, of which the following is an abstract:

To show the rapidity of corrosion, the author makes some quotations from a paper on "The Corrosion of Boilers and Steamships,"* opening as follows:

Experiments conducted by the Admiralty, Board of Trade and Lloyd's prove that steel corrodes much more rapidly than iron when exposed to the action of salt water; also, that the commoner brands of iron corrode less than the better brands when exposed to the same influence.

With steel unprotected and exposed to the action of the weather and sea-water, corrosion advances at the rate of 1 in. in depth in 82 years, while under the same conditions for iron the rate is 1 in. in 190 years. When exposed to the weather and fresh water, the corrosion is at the rate of 1 in. in 170 years for steel and 630 years for iron. When always immersed in sea-water, the periods are 1 in. in 130 years for steel and 1 in. in 310 years for iron; and when always immersed in fresh water, the periods become 600 years for steel and 700 years for iron.

These conclusions are the results of years of patient experiment and observation by Mr. Parker of the Board of Trade and Mr. Phillips of the Institute of Civil Engineers.

The bad effect of mill scale in aiding corrosion is then explained and the necessity of removing it from ship plates before application, which can best be done by pickling. Mr. Wood calls attention to the necessity of removing scales and punchings from the framework of vessels, as well as from their outer coverings.

Zinc, presumably in the form of plates, to prevent boiler corrosion, is mentioned by Mr. Wood as in use on the Allan, Cunard, Bedouin, Forwood, Red Star, McIver and other steamship lines, and also in the French, Chinese and Japanese navies. The zinc pieces, as applied, are termed electrogens. They are fitted to boiler shells by screw studs.

A large part of Mr. Wood's paper is devoted to a discussion of galvanizing as a protecting surface for iron and steel work. Regarding methods of galvanizing, he says:

Certain fallacies existed for a long time as to the relative merits of the dry or molten and the wet or electrolytical methods of galvanizing. The latter was found to be too costly and slow, and the results obtained were erratic and not satisfactory and soon gave place to the dry or molten bath process as in practice at the present day; but the difficulty of management in connection with large baths of molten material, the deterioration of the bath, and other mechanical causes limit the process to articles of comparatively small size and weight.

After some discussion as to the relative merits of the two processes and an allusion to the difficulties involved, and the dangers incurred in galvanizing iron and steel wire through reducing the strength, distorting and rendering brittle the metal when in small sections, Mr. Wood proceeds as follows:

The English manufacturers have ceased galvanizing their high-grade steel wire that costs some $175 per ton, on account of the great risk of rendering it worthless, which is clearly a disadvantage, although the advisability of protecting the steel is unquestionable, as corrosion is found to be very marked on the inner strands of ropes or cables formed from uncoated wires.

The Cowper-Coles or cold galvanizing process is in operation at the works of Messrs. Laird Bros., Birkenhead, England, and used for the purpose of zincing the skin plates and frames of the torpedo boats and torpedo-boat destroyers built by them for the English Navy. A plan and elevation of this plant are given in "The Engineer," Feb. 28, 1894. No detail of the cost of working the process, as applied to armor skin plates, frames, or other heavy articles, is given. The cost must necessarily be less than electro-plating with copper, as given by the Tacony people in the preceding paper (No. 598, vol XV., 1894), not only in regard to the difference in cost of two metals used, but also the electromotive force required, the cleaning of the plates from mill scale and the dirt of machining processes being an indispensable condition in this process as in all other preservative methods.

The industrial importance of the successful application of this cold galvanizing process can hardly be overestimated, even if its application is only to the marine constructions of the future, and it is found to be in any degree inapplicable to those of the past, and that constitute our present structures and vessels in use. The permanency, continuity, strength and density of the coating given by this process being found in all respects equal to that of hot galvanizing, the thickness of it can be made superior to that given by the hot. Considering the success that has attended the use of zinc to prevent corrosion in marine boilers with concentrated hot saline fluids as the excitant medium, aided by the electrical conditions attendant upon the combustion of large quantities of fuel, and the changes in temperatures in various parts of the same boiler or group of connected boilers, all of which conditions are conducive to galvanic action, it may not be considered a wild prophecy to expect that, with all of the internal metallic parts of a steam vessel protected by zincing, and by virtue of the constructive features in close contact with each other, and the bilge-water spaces filled with a corrosive liquid ready to act upon any immersed metal electro-positive to the metal forming the ship, that an application of zinc plates secured to the framework of the structure similar to the application of zinc to marine boilers, that these plates may receive the energy of corrosion and, if not neutralizing it entirely, at least pass it along in the form of a deposit upon the submerged portions of the vessel, or to convenient pockets where it could be removed, the same as is now done to the washings and dirt from the fireroom bunkers and ballast chambers.

This internal electro-chemical process of protection does not appear so chimerical as at first one might suppose. Dr. Henry Wurtz* has proposed the protection of mining plants subject to the intensified corrosion due to the decomposition of pyrites and other minerals in the mine waters, by connecting all of the metal portions of the mine as the negative elements with a dynamo of sufficient force to overcome the strength of galvanic energy due to the surfaces exposed excited by the corrosive liquids in the mine, the positive terminal to be connected to a mass of hard coke in the mine sump; conditions varying but slightly from those existing in the ship, and it is not improbable that experiment will determine that both these systems could be made to work together.

Thermo-electric currents arise from changes of temperatures in all bodies, and set up voltaic action in all cavities, fissures, seams and contact surfaces in the metal, which, though slight and not easily detected, will in time enlarge and waste them away sufficiently to sap the strength of the mass.

Metallic salts and acids in mine waters intensify the corrosion of all metals exposed to their action either by direct contact or immersion or by condensation of the vapors in the mine. The metal work of railway tunnels is also disastrously affected by the condensed vapors of sulphur, carbonic acid and the ever-present moisture due to such locations, the corrosion of the metals decreasing the resistance of the water to voltaic circuits; this corrosion by liquids being voltaic phenomena in all cases, and in many cases is intensified by the moisture being in the form of drops instead of being uniformly spread over the whole surface.

Acids and acid salts, which are capable of taking up iron oxides into solution, still further enhance the destruction by removing such oxides and exposing the surfaces of the metal to a fresh attack of the corrosive element; but the saline matter in solution that excites voltaic action need not be acid. Any neutral salt which decreases the resistance of the water will qualify to act as the necessary liquid medium of a voltaic circuit. Sea-salt is the commonest of all such neutral salts, together with the other chlorides and sulphates of sea-water. It enables corroding voltaic action to be set up on all ferric bodies immersed therein or in the air impregnated with their substance.

The power of resisting corrosion, it appears from instances cited, is greater in strained than in unstrained metals, but where strained and unstrained metals are brought together, there is a tendency to set up local galvanic action, so that the total corrosion may be more than in unstrained metal alone.

As to the relative corrosion of cast and wrought iron, when exposed constantly to salt water, Mr. Wood states that the experiments are somewhat conflicting, but after quoting from some articles on this point, he concludes that cast iron has greater resisting power. This may be accounted for, he says, by the cast iron "being covered with a skin of silicate of protoxide of iron, produced by the molten metal fusing the sand in the mould, as well as to the film of magnetic oxide of iron formed at the same time by oxidation of the hot metal.

Regarding the corrosion of iron under varying conditions, the author says:

Iron exposed to tidal wash, and alternately wet and dry, is more liable to rapid waste, unless well protected, than when wholly immersed in water or wholly exposed in the air.

Corrosion is accelerated by impurities in the water, and especially by the presence of decomposing organic matters or free acids, and chlorines discharged from many manufacturing establishments, rolling mills, blast furnaces, paper mills, bleacheries, etc. It is also accelerated by contact with any other metal or substance that is electro-negative to the iron, or where two masses of the metal are in different conditions as to density or temperature. In general, hard, crystalline iron, whether cast or wrought, is less corrosive than ductile, soft, and fibrous qualities.

Examination of the iron piles in the South Bassien bridge on the Bombay, Baroda & Central India Railway led to the conclusion that the greatest corrosion in cast iron piles exists close to the low-water mark, and does not extend to any considerable depth below it, a conclusion which also applies to bolts and braces. After an exposure of 25 years, the piles were found in very good condition, and corrosion had only occurred in places easily accessible for renewals and repairs. A thin coating of mud, marine growth, and barnacles, by which the surface of immersed iron piles and pier work are protected from contact with fresh supplies of water, has a tendency to retard corrosion; but when these growths are removed, corrosion is increased at once.

Mr. Kinniple remarks "that after a life of from 30 to 50 years, structures depending upon cast iron exposed to the rapidly-oxidizing action of sea water can only be looked upon as of a comparatively temporary character, especially as regards very light cast iron pile structures."

After his extended consideration of galvanizing processes, the author discusses various compound applied to the outside of ships, to prevent corrosion, under five heads, as follows:

(a) Oil paints.
(b) Pitch, asphalt, tar, or waxes.
(c) Varnishes consisting of resins and gums dissolved in volatile solvents.
(d) Varnishes containing substances to give them body.
(e) Coatings of cement.

Classes (c) and (e) are not judged suitable for practical use, the special varnishes in this class being acted upon, the author states, by moisture, while the cements have been entirely abandoned for outside protection, though still used inside. Regarding the other three classes of coverings noted above, the author says:

The protective coverings (in the above list and excluding (c) and (e).—Ed.) for the outside or bottom of ships appear to rank, (b) pitch asphalt, tar and waxes; (d) varnishes containing substances to give them body, i. e., oxide of zinc and oxide of lead either alone or in combination with each other; (a) pure red lead and linseed oil paint. The conditions under which any of these compounds can be applied with a fair measure of trust in their effectiveness are: that the compound should not be too thick to spread well, and should be well worked with the brush to the surface of the metal that it covers; that the air should be as dry as possible, and the plates of the ship not only free from mill scale, but clean and free from all oil and dirt due to machining processes, handling, scaffolding, also from any indication of sweating; and if the plates can be warmed either by the sun or by artificial heat, the better will be the result. Too much drier in the form of volatile solvents must not be used. A paint that dries in four hours cannot, in the natural course of things, be as good as one that dries in as many days. If the plates and frames have been galvanized by either the hot or cold process, then the principal pigment in the composition must be oxide of zinc, in order that any galvanic action due to immersion in the sea water may be at the expense of the renewable zinc in the pigment, instead of the zinc coating on the metal; and the pigments used with the zinc oxide, to give body to the paint, must be ground barytes, or silica, both neutral electrically, and not broken down by moisture as the other above-mentioned pigments are.

The causes and extent of the internal corrosion of ships have been referred to hereinbefore, and the main classes of protectives are, (1) cements, (2) bituminous coatings, (3) paints.

The rigidity, firmness of adherence, and endurance of cement coatings are all points of the greatest advantage; the silicates present in the cement not only bind it into a mass of wonderful hardness, but also bind it to the iron. A drawback to the use of cement consists in its porosity, that allows it to be permeated

*A paper read before the Goldsmith's Engineering Society, and published in "The Practical Engineer," London, Sept. 21, 1894, Vol. X., No. 395, pp. 224-226.

* "Engineering Magazine," May, 1894, vol. VII., No. 3, p. 297, "Preservation of Metals from Corrosion by Electric Polarization."

by gases and liquids; and if by any accident copper scale or scrap from the interior fitting reaches the warm bilge-water, charged as it ever is with more or less sulphurous and other acids from the coal bunkers and ashpits, and carbonic acid gas, the soluble salts of copper thus formed will soak through the cement, deposit the copper upon the iron skin or frame, setting up galvanic action, corroding the iron, the formation of the rust loosening and pushing up the cement, and allowing corrosion to extend its area and depth with but little or no sign of the damage taking place below it.

The hardness and rigidity of the cement give it a tendency to flake off from the iron under strains due to the expansion and contraction of the metal, mechanical injuries from stowage of cargo and stores, repairs to the vessel, riveting, etc. These injuries, though local or of minor extent, become starting points for corrosion that generally becomes serious before discovery, owing to their location in the confined spaces of the ship where inspection is difficult.

The quality of the cement used has much to do with its effectiveness as a coating. As a rule, but little attention is given to the quality of the cement used, or to the manner of preparing it for coating, or the length of time between its preparation and application, all points of extreme importance to secure a good result, but all in general left to the care of the lowest grade of labor about the shipyard; and the precautions that the builder of a common sewer would insist upon to get a good job are ignored, though the comparative interests involved are as thousands to one.

For the above reasons it is considered that bituminous or asphaltic varnishes properly prepared by being freed from any acids that are present in their crude state, and applied hot to warm metal, are far superior to cement coatings for the internal work of a ship; also red-lead pyrolusite and other tough paints free from oxides of iron form effective coatings, preference being given to the lighter colors, as corrosion, if set up, is quickly discovered and easily repaired. If the frames and interior fittings of the ship have been galvanized, then the precautions mentioned for like cases on the external portions must be observed.

Some ten pages of this paper are occupied with quotations in relation to the fouling of ships' sides and bottoms, and means employed to prevent such action:*

After these extracts, follows a review of some tests made in 1885 by the United States Navy Department to determine the merits of paints and anti-fouling and anti-corrosive compounds for wetted surfaces submitted by 60 different firms in the United States, Canada and England. The report on these tests was made from the League Island Navy Yard, Philadelphia, Sept. 1, 1886, by Naval Constructor Wm. H. Varney, U. S. N. The report is now out of print. The paint that stood test on the "Speedwell" was a U. S. Navy experimental coating of two coats of white zinc.

The concluding part of Mr. Wood's paper, relating to the protection of bridges and structural iron and steel work, we have slightly condensed, as follows:

The advent of 70 to 90-ton locomotives, in connection with heavier rolling stock and loads in the railway service of the country, is requiring the reconstruction of most of the iron bridges and viaducts that within the past 30 years have replaced the olden-time wooden structures. It is possible that no material increase in the weight of a railway train per foot of track will be made to the present standard to require their substitution by heavier constructions. This being the case, the preservation of them from corrosion, as well as the protection of the immense roof trusses that span the large railway stations, armory drill rooms, warehouses, etc., becomes a question of extreme moment, as properly protected by paint compounds, which thus far appear to be the only practical method, they should last for centuries instead of decades.

But the methods of painting of the present day must be entirely changed to counteract the results that past practice has found to be inadequate to prevent corrosion for even a few years. (1) The mill scale and dirt due to machining processes must be pickled off and the metal left clean and bright ere it receives its first coating; and if the metal can be warmed, even to temperatures due to sunny days, the results will be noticeably better than when the paint is applied on damp and cloudy days, or even in ordinary weather. (2) The various members composing the truss or structure must receive at least one coat of pure red lead, pyrolusite, graphite, lampblack, or kindred non-corrosive, linseed oil, or asphaltum paints, free from any percentage of mixture with iron oxide or so-called inert pigments, such as the sulphates and carbonates of lime, pipe-clay, feldspar, etc., all substances decomposed by moisture, and that can in no manner enter, and never have entered, into any combination with the oil and before-named pigments, but only serve as stuffing to make the application of the paint a little easier for the painters. (3) All bolts that connect any part of the structure should be painted with the selected paint, or with a pure red-lead paint, before being put into the holes, and the threads coated before the nuts are run on and screwed to place. All such bolt-heads and nuts must be painted before sweating or rusting takes place, and all hot rivets driven should be scaled and painted while warm, as corrosion once started in these weak points of the structure extends rapidly in the form of pitting. (4) Benzine driers and bi-sulphide of carbon solvents must be positively excluded from the paint compounds, as well as from the washing down of any dirt due to assembling and erecting the parts.

The Frith of Forth Bridge—a structure that contains more iron and steel with a greater number of separate parts and a greater amount of exposed surface, and is subject to a greater complexity of strains, than any construction ever erected for human needs, or that will probably be erected within the next generation of mankind—by reason of its exposed position, subject to driving storms of rain and hail, sea-air, and spray, should have been treated from the first in a manner that would reasonably have led one to expect for it a life of centuries instead of decades, and these will only be had through tribulation and sorrow.

No attempts were made to remove the mill scale from the thousands of pieces of iron and steel that comprise the structure, but a coat of good red-lead paint was given the several parts in general before they left the workshop or mill yard. No special care was taken to coat them before they were rusted by sweating, or to remove the oil and dirt due to the machining process of the workshop or those due to transportation and erecting. Two coats of red-lead paint were applied at first after erection, followed by two coats of oxide of iron paint. It has been decided by the bridge officials to keep a corps of painters continually in service and to practically repaint it every three years in its early life, until time has developed the weak or danger points from corrosion, and what methods and compositions other than the above-named paints are needed for the preservation of this important structure.

I believe—with the exception of the red-lead paint, and this was wrongly applied—that every step in the methods adopted for the preservation of this bridge was radically and entirely wrong; and, before 50 years have passed, that corrosion will be so strongly developed in all parts of the structure that a drastic plan of burning, scraping, and pickling all the paint compounds off will have to be pursued, and when the metal is scoured to the bright, regardless of expense, a paint can be applied with some chance for its being effective against corrosion, but no oxide of iron will enter into its composition.

At the recent annual convention of the American Institute of Architects, in a discussion on the use of iron and steel in the construction of modern high buildings, it was reported by one of the leading architects in the United States that the iron floor beams removed by him from the old "Times" building, though in use only 35 years, were rotten with rust. They were inclosed in 8 ins. of brickwork and had been well painted with oxide of iron paints and protected by asphaltum coverings. The iron came off in strips, clearly showing that the rust had followed the lamination of the iron.

The Victoria Bridge across the St. Lawrence River at Montreal has become so seriously corroded, though under constant care by the engineers and a corps of painters, that the whole floor-beam structure required renewal, it being found impossible to repair the old beams, as the cutting out of one rivet was followed by the loosening of all those in its immediate vicinity, all being pitted around the heads and points, and in many cases the body of the rivet and the surrounding metal showed corrosion to a marked degree. The renewals comprised 656 new floor beams, 15¾ ft. long, weighing 2,100 lbs. each, placed on 7-ft. centers between the old ones that it was found impossible to remove. From the present outlook, this important structure will be either condemned and taken down, or else will fall from corrosion, and fall into the river within a century from its construction. The mill scale was left on the plates as they were originally put into the structure. No care was taken to paint the plates before rusting, and the sucessive coats of iron oxide paint have been applied over each other without scraping them off, until a flake of paint coating shows the successive coats, alternated with rust, as plainly indicated as the leaves in a book.

* "The Corrosion and Fouling of Iron and Steel Ships," a paper read at the 30th session of the Institution of Naval Architects by Prof. Vivian B. Lewes, F. R. S., F. I. C., Royal Naval College Associate, April 12, 1889; published in full, "Scientific American Supplement," vol. XXVIII., No. 709, Aug. 3, 1889.

LAND RECLAMATION AT BOSTON, MASS.

This is a time for taking an account of stock, in area, houses, and people, in all our larger cities, and City Surveyor Pierre Humbert has recently made a report covering the growth of Boston since 1722.

From the maps accompanying the report and the text explaining them, it seems that the original land area of Boston was 783 acres in 1722, with a population of 10,567. The present total land area is 24,087 acres, with a population of 439,507 in 1890. Annexation of territory commenced in 1804 by filling in the North Cove, and this reclamation of tidal lands has continued until 2,245 acres have been thus added to the land area of the city. Much of this filling has been done by individuals and corporations, and, in fact, the larger portion of all the railway terminals in Boston, both freight and passenger, all the present wharves, most of the great warehouses, and the greater part of the wholesale business district, are located upon reclaimed land. The old colonial law fixed the boundary of property at low-water mark on all tidal lands, and gave title of ownership to abutters on flowed lands without purchase, and for the mere cost of filling up. This law, of course, had a marked effect in encouraging reclamation by individuals and corporations. In the Back Bay section of Boston, individuals filled up 462 acres, and the state reclaimed 108 acres. The work carried on by the state was extremely lucrative, as Mr. Humbert gives the aggregate cost at $1,640,300, and the gross income from land sales, exclusive of land donated, was $4,708,936. Large areas were given away to the Massachusetts Institute of Technology, to other institutions, and to the City of Boston. The assessed valuation of these Back Bay lands was $146,480,500 in 1892.

The South Bay is another area in which much has been done, but much more land still remains to be filled up. Mr. Humbert estimates that the ultimate money profit to the State that would accrue from filling in the Commonwealth Flats in South Boston would amount from $3,000,000 to $4,000,000. This is in addition to providing much available territory for wharves, warehouses and factories. In his report he shows 2,700 acres still available for filling in, within the present limits of Boston. It is also pointed out that an area of about 1,900 acres contiguous to the ship channel is available for filling in; and that this reclaimed land, with its docks and wharves, would do much for the commercial future of Boston.

Mr. Humbert favors state ownership of water-front, docks, etc. He bases his conclusions upon the experience of California, which has in 30 years established a system of docks and warehouses in San Francisco, at a cost of less than $12,000,000; and with exceedingly low charges for wharfage, the project has completely paid for itself, and shows a net income above all costs of $350,000 per annum.

CABLEWAY FOR PASSENGER TRAFFIC AT BRIGHTON, ENGLAND.

In the neighborhood of Brighton, England, is a deep gorge, known as the Devil's Dyke, and this has been recently spanned by a cableway for passenger traffic. It was built by Mr. W. J. Brewer, of London, and is described, in a recent issue of "Engineering." The two towers, Fig. 1, are 650 ft. apart, and connected by a single suspension cable, with a sag of 26 ft. The two track cables are suspended from this, and are practically horizontal, so that the pull on the hauling rope does not alter with the position of the car. The suspension cable is 1,200 ft. long, securely anchored, and the suspension rods are of steel, 1 in. diameter, with anchor-shaped steel castings at the lower end, to support the two 1-in. track cables, 18 ins. apart, as shown in Fig. 2, while these suspension castings also carry 1½-in. pulleys to support the hauling cable. The elevation is 230 ft. above the lowest part of the valley. The passenger cars are 7 × 5 ft., with frames of iron rods and sides of stout wire netting, and carry eight persons, sit-

ting back to back. They are suspended from the two track ropes by four pulleys attached to the inwardly-curved ends of the four main rods of the car. Thus the pulley axles are always outside the track ropes, and always at the same distance apart, and the pulleys cannot get off the ropes. This arrangement has also the advantage that no provision has to be made for clearing the supports of the roadway at any point, as the cars pass freely within the supporting columns. The endless hauling rope is

FIG. 1. PASSENGER CABLEWAY NEAR BRIGHTON, ENGLAND.

driven by a 4½-HP. Crossley oil engine. The car can be gripped to either portion of the hauling rope, and its course can be controlled on the journey if required. An electric telegraph wire is permanently provided for communication along the line, available alike to cars and stations. The time occupied in transit between the terminal stations is 2½ minutes. The line was opened in October, and had carried about 4,000 passengers by the middle of December. It is proposed to construct an inclined line on the same system down into the valley, for freight and passenger traffic, as the distance by road from the bottom of the Dyke to Brighton is now about 15 miles, while by the cableway it would be only about four miles. We are indebted to "Engineering" for the information from which the above description is made and for the illustrations accompanying.

THE BRAZOS RIVER HARBOR WORKS.

As announced in our issue of Jan. 3, arrangements have been made for the reorganization of this enterprise, which contemplates the construction of a deep-water harbor on the Texas coast at the mouth of the Brazos River. The past history of this work has been recorded in our issues of May 18 and June 22, 1889, April 4, 1891, and Nov. 23, 1893. As the probabilities are that work is to be again resumed, we present herewith a summary of the history and present status of the enterprise, from facts furnished us by a correspondent who has been familiar with the work from its inception.

For over half a century the mouth of the Brazos River has been regarded as a port where a deep-water harbor could be more easily constructed than at any other point on the Texas coast, yet none of the six attempts to make the improvement have been carried to a successful completion. If newspaper notices are correct, the seventh is now being started under conditions favorable for adding another failure to the list.

In 1857 the state of Texas appropriated $60,000 for the purpose of improving the harbor, but the results obtained were only temporary. In 1866 the Brazos Internal Improvement & Navigation Co. was incorporated, with a capital stock of $1,000,000. The failure to raise money, followed by the financial panic of 1873, crippled the company to such an extent that no work of improvement was ever started. From 1874 to 1887 the general government undertook to solve the problem of opening a channel across the bar at the mouth of the river, but after expending $158,750, abandoned the enterprise, with the statement that "The attempt to make any improvement at all is a costly and doubtful experiment." In 1888 the Brazos River Channel & Dock Co. was chartered by the state of Texas and the general government, and during 1889, 1890, and 1891 made three attempts to open a deep-water channel across the bar; and although neither was carried to a successful completion, the fact was clearly demonstrated that if the works had been completed as designed by the engineer in charge, the result desired would have been obtained. The work done and the results obtained by this company were fully discussed in the "Transactions Am. Soc. C. E." for November, 1891, and in the Engineering News of Nov. 23, 1893.

The conditions existing at the time the latter article was written have remained practically the same since that date, and indicate that with well-designed plans and work properly executed a 20-ft. channel could be obtained in a very short time.

In September, 1894, Mr. Geo. Y. Wisner, who constructed that portion of the jetty works which has remained in place, was again asked to make an examination of the works and report the probable cost to permanently complete them so as to make and maintain a 20-ft. channel across the bar.

His report was to the effect that, if conducted with modern plans and under good economical business methods, the work need not cost more than $150,000. No plans were asked for, and none were furnished with the report. On the strength of this report, however, the company was reorganized, money was put up to complete the jetties, and contracts were let for doing the work, as announced in our issue of Jan. 3.

The strange part of the arrangement is that the new organization is apparently going ahead with the construction without even asking professional advice, except so far as to inquire what the work ought to cost. In an interview in the "Velasco World" for Dec. 22, 1894, the president of the new company stated that "no engineer will be employed for the present, but when it comes to building up the outer walls and cribbing and capping the jetties, an engineer will be put in charge." It appears likely that if this programme is carried out, Mr. Wisner's estimate will need to be doubled before the work is completed.

The sales of property at Velasco since it became

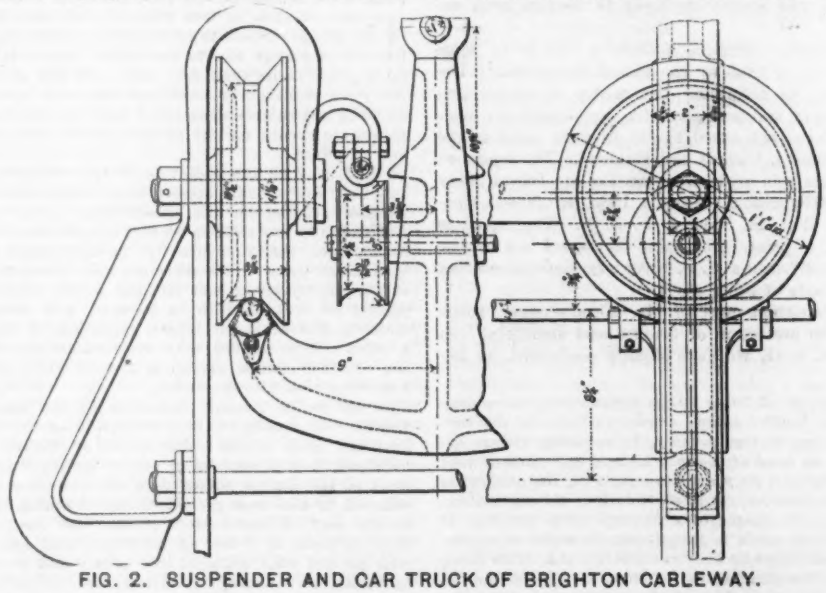


FIG. 2. SUSPENDER AND CAR TRUCK OF BRIGHTON CABLEWAY.

certain that a deep-water harbor could be made there are said to have amounted to nearly $1,500,000, and the interested parties thus indirectly brought into the enterprise are naturally anxious that the work now being started shall be conducted on such a basis that the final results will be more encouraging than that of previous attempts.

As soon as the organization of the new company was completed, the dredge boat recently used at Tampico, Mexico, was chartered to cut a channel across the bar, and a contract was entered into with Capt. Fred. A. Brock, of Galveston, Tex., for rock, material, and labor to complete the jetties.

Recent telegrams from Tampico state that the dredge left that port on Jan. 7, and on the following day went down, about 100 miles north of that place, during a violent gale on the Gulf. Capt. Brock, his wife and two children were among the missing. The great executive ability of Capt. Brock, and his long and successful experience on this class of work, were considered by many to be the redeeming feature of the new undertaking, and his loss will no doubt be a serious setback to the project. The loss of the dredge, however, will probably make no material difference with the success of the work, as experience has long since shown that no channel could be made permanent on the Brazos until it is properly protected by jetties.

GEORGE S. MORISON, PRESIDENT AMERICAN SOCIETY OF CIVIL ENGINEERS.

(With portrait.)

Mr. George S. Morison, elected President of the American Society of Civil Engineers at the recent annual meeting, was born at New Bedford, Mass., on Dec. 19, 1842. He was the son of John Hopkins and Emily (Rogers) Morison, of sturdy New Hampshire Scotch-Irish and English stock. As a boy George S. Morison lived in Milton, near Boston, and was fitted for college at the Phillips Exeter Academy, of which institution he has been one of the six trustees since 1888. He was graduated from Harvard College in 1863, and, having studied law, he received the degree of LL. B., and was admitted to the New York bar in 1866; but he never practiced in this profession.

In October, 1867, he sought his first engineering employment in connection with the Kansas City bridge, then being built over the Missouri River, under Mr. Octave Chanute as Chief Engineer. He remained at Kansas City, engaged upon bridge and railway work, until 1871, when he removed to Detroit, and until 1873 was Chief Engineer of the Detroit, Eel River & Illinois R. R., in Indiana. In April, 1873, he came to New York, as Resident Engineer of the Eastern Division of the Erie Ry., and was later the Principal Assistant to the Chief Engineer, Mr. Octave Chanute. He remained with the Erie Railway until November, 1875, and during this time rebuilt in iron the famous wooden Portage Viaduct, which was destroyed by fire on May 6, 1875.

During the ten years, 1875-1885, Mr. Morison was largely engaged in consulting work on railway properties in the United States, having a regular business engagement to and with Messrs. G. G. & G. C. Ward, the American agent for the famous Baring Brothers, of London. In this connection Mr. Morison served as a Director on the boards of the following railways: The St. Louis, Iron Mountain & Southern, 1876 to 1880; the Eastern Railroad of Massachusetts, from 1876 to 1886; the Maine Central, from 1877 to 1885, and the Ohio & Mississippi R. R., from 1884 to 1892. About this same time the firm of Morison, Field & Co., bridge contractors, was formed; but Mr. Morison, preferring engineering work proper to contracting, soon retired from this business.

In 1887 Mr. Morison removed his office and resi-

dence to Chicago, though he still retained a branch office in New York. Until 1889 he was associated in engineering practice with Mr. E. L. Corthell, the firm being known as Morison & Corthell. As Chief Engineer, Mr. Morison has built the following bridges over the Missouri River: Plattsmouth, 1879-80; Bismarck, 1881-82; Blair Crossing, 1882-83; Omaha, 1885-87; Rulo, 1885-87; Nebraska City, 1887-88; Sioux City, 1887-88; Bellefontaine, 1892-93; Leavenworth, 1893. Across the Upper Mississippi River, as Chief Engineer, he built the Winona bridge, 1890-91; rebuilt the Burlington bridge in 1890-91, and built the Alton bridge in 1892-93. He also built the Cairo bridge, across the Ohio River, in 1887-89, and the Memphis bridge across the Lower Mississippi, in 1889-92. He was Consulting Engineer and made the plans for the Merchants' bridge, at St. Louis, and was Consulting Engineer for the crossing of the Willamette, at Portland, Oregon; the Riparia bridge, across the Snake River, and the crossing of the St. John's River, at Jacksonville, Fla. In addition to these he built a number of smaller bridges and viaducts for various companies.

In 1894 he was a member of the board appointed by President Cleveland to report on a safe and practicable span for a bridge across the Hudson River, at New York. Mr. Morison was made a Member of the American Society of Civil Engineers, Jan. 6, 1875. He is also a member of the Western Society of Engineers, of the American Institute of Mining Engineers, of the American Society of Mechanical Engineers, and is a Member of the Institution of Civil Engineers of London, and an Assoc. Fellow of the American Academy of Arts and Sciences. In Chicago, Ill., he belongs to the Chicago and Union Clubs; in New York city, to the University and Engineers' Clubs and to the Down-Town Association; in Boston, to the Union Club, and in St. Louis, to the St. Louis Club.

E. F. C. DAVIS, PRESIDENT AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

By Angus Sinclair, M. Am. Soc. M. E.
(With portrait.)

Mr. E. F. C. Davis, whose election as President of the American Society of Mechanical Engineers was announced at the recent annual meeting of the society, was born in 1847, at Chestertown, Md., a small village on the Eastern Peninsula. His family were of Welsh extraction, but had resided in Maryland for several generations. It was the settled purpose of Mr. Davis' parents that he should be a lawyer, the profession that his father and grandfather had followed; and with that in view he received a classical education, and was graduated from Washington College, Maryland, in 1866. From his earliest boyhood, however, Mr. Davis had shown a decided fondness for mechanical pursuits, and as he grew older his distaste for the profession to which his parents destined him became more pronounced.

That an intelligent youth should prefer the hard and dirty manual labor involved in the choice of a mechanical life to the dignity and social standing which he might expect in following his father's profession, seemed a foolish and inexplicable whim to his parents and friends,and every possible means was taken to turn his attention from the direction whither his natural tastes drew him. At that time mechanical engineering in this country was in its infancy, and for a youth of good family, fine education and excellent prospects to turn to mechanical pursuits did, indeed, seem veritable folly.

Young Davis' natural inclinations, however, were stronger than the influence of friends and parents. During the last months of his school life he devoted his leisure hours to making, with his own hands, a working model of an oscillating marine engine. When completed the little engine worked perfectly, and showed such excellent workmanship that the youth's mechanical talents were reluctantly conceded by his friends, although they still opposed his adoption of the profession for which he was manifestly fitted. Finally, however, the boy's firm determination to become an engineer carried the day, and his parents sent him to Philadelphia to see if he could find an opening in some engineering establishment, thinking, no doubt, that a short experience of hard work and long hours would wean him from his fondness for mechanical pursuits.

In Philadelphia, young Davis lodged at the house of relatives, and spent many days in a fruitless search through the city to find a shop which would admit him as an apprentice. He was about giving up hope when Mr. Henderson, a Scotch engineer of the old school, and a member of the firm of Brinton & Henderson, called at the house where Mr. Davis was staying, and was shown the working model. This excited his interest in the maker, and on being told that he wanted to learn the machinists' trade, Mr. Henderson invited him to enter the Hydraulic works of Brinton & Henderson as an apprentice. Mr. Henderson proved a very good friend, and did all in his power to give the youth an opportunity to learn every department of the business, and the opportunity was not neglected.

Mr. Davis left these works after the conclusion of his apprenticeship, a good machinist and a competent draftsman. He went from Philadelphia to New Castle, Del., and entered the employ of Hoy, Kennedy & Co. While with them he assisted in the transfer of their plant from New Castle to the Atlantic Dock Iron Works, South Brooklyn, N. Y., and had charge of arranging and fitting up the new machine shop. After the works were in running order he was engaged in making drawings for the Mutual Gas Works, which were built on the site of the old Novelty Iron Works, on East River, New York.

For several years he took a hand in all the kinds of engineering work that comes to a general engineering establishment, and then he left Brooklyn to accept a position as draftsman with the Pottsville Iron & Steel Co., a concern which was then doing business in a small way, and was just beginning to develop the machinery required for extended work. Here Mr. Davis obtained much valuable experience, first in effecting improvements upon the older forms of machinery, and afterwards in designing and erecting new and improved plant for the company's works.

His next change was to the position of draftsman and assistant to Mr. S. B. Whiting, Superintendent of the Colliery Iron Works at Pottsville, Pa. These works made a specialty of the most improved and best types of machinery for coal mining. The coal mining machinery of Pennsylvania was much more crude at that day than at present and there were excellent opportunities for an ingenious designer to make valuable improvements.

About this time the Philadelphia & Reading Coal & Iron Co. was formed, with great capital and influence behind it, and soon absorbed most of the anthracite collieries in the region about Pottsville. In 1878, Mr. Davis, who had won an excellent reputation by his work in Pottsville, entered the service of the company, first as mechanical draftsman. A year later he was made superintendent of the company's shops at Pottsville, which were then being established for the purpose of building and repairing all the mining machinery required in the whole of the collieries operated by the company. In 1883 the Colliery Iron Works were added to this plant.

The work of organizing this large establishment fell principally upon Mr. Davis, who won much credit for the manner in which the work was done. In 1887 Mr. Whiting resigned the position of mechanical engineer for the company, and Mr. Davis was advanced to that position, in which he had charge of all shops and machinery.

He remained in this position for three years, and in 1890 resigned to become general manager of the Richmond Locomotive & Machine Works, which position he still holds. During his administration these works have built the engines, boilers and machinery for the United States armored battleship "Texas," and the works have been developed from shops originally designed for building stationary and portable engines and saw mill machinery to a thoroughly modern and well-equipped locomotive plant.

In connection with his management of these works, Mr. Davis settled a most difficult industrial problem in a way that reflects the greatest credit upon his tact and judgment. It is well known that in all the older locomotive building works the system of production has been developed gradually by a system of sub-division of labor until nearly every operation is done by a specialist who can do little else. These special workmen finish work rapidly, accurately and so cheaply, that new concerns employing ordinary mechanics on the operations find their cost of production so high that they cannot compete with the older works. The mechanics oppose the introduction of piece work and object to men running more than one machine. By some means Mr. Davis succeeded in training up a class of special workmen, and finally overcame all the internal opposition raised to the introduction of the best methods of manufacture.

Mr. Davis was one of the earliest members of the American Society of Mechanical Engineers, joining the society in 1881, the year following its organization. He was a vice-president from 1891 to 1893. He is also a member of the American Railway Master Mechanics' Association. He has made a special study of the subject of compound locomotives and has designed an engine of this type, which has shown excellent records, as described in our issues of May 10 and May 31, 1894. Mr. Davis has been for some years an influential member of the Board of Managers of the Virginia Mechanics' Institute, of Richmond, and is now chairman of the committee on night schools, which committee really has most of the work to do in connection with the management of the institute.

Mr. Davis' social characteristics have won for him a large circle of friends. He is especially fond of entertaining at his home bright men interested in engineering works, and in this way many lifelong friendships have been formed.

STEEL AXLES.

At the meeting of the New York Railroad Club on Dec. 20, 1894, Mr. Lewis R. Pomeroy, Assoc. M. Am. Soc. M. E., read a paper upon steel axles and the requisite qualities in such axles for railway purposes. For encountering exceptional stresses without serious results, and for the other requirements of axle metal, the author believed that steel of the grade now used in axles more completely meets these requirements than iron. Steel is homogeneous, more ductile, and more uniform, both in structural arrangement of the molecules and in the distribution of chemical elements. Steel possesses in a greater degree the quality of density, and is consequently harder, and thereby able to carry a greater load per square inch of metal. The higher elastic limit of steel gives it a wider range to the strain-bearing properties of the metal and a higher factor of safety. Journals of steel axles do not groove so easily, and are not prone to twist off when overheated, as a result of defective lubrication.

Mr. Pomeroy then pointed out the greater range of useful work in steel; and he illustrated this by noting the specifications of a prominent railway using steel axles exclusively. These specifications called for a lower limit of 75,000 lbs. per sq. in. tensile strength with an elongation of 15% in 2 ins., without prescribing an upper limit. But this company accepts axles of 95,000 lbs. tensile strength and 25% elongation, and even higher than this is considered safe. This means a range of 20,000 lbs. in tensile strength and 10% in elongation. But an iron axle below 48,000 lbs. per sq. in. tensile strength is too soft, and if above 55,000 lbs. tensile strength it is liable to be "red-short" and brittle. The range for iron axles is thus only 7,000 lbs.

The experiments on axles of Chief Engineer Wohler, of the Prussian State Railways, are then referred to. With his machine Wohler found the breaking strain of fibrous iron to be from 20,160 lbs. to 22,400 lbs. per square inch, under conditions which produced alternate strains of compression and tension. Under similar conditions, soft steel broke under 26,880 to 33,600 lbs. per sq. in. In further tests, in which the fibers were strained in the same direction each time, with a tension varying from zero to the strain imposed, fibrous iron broke at a tensile strain of 33,600 to 40,320 lbs. per sq. in., and soft steel at 50,400 to 56,000 lbs. per sq. in. Wohler also made extensive experiments to determine the effect of stretching, bending and twisting pieces of iron and steel to a given maximum stress, the load being wholly or partially

removed each time. The number of repetitions necessary for fracture was found to vary, not only with the magnitude of maximum stress, but with the fluctuations. It was greater when the load was only partly removed than when it was wholly removed. The following table shows the limits between which the stress varied when, with an unlimited number of loadings, the axle was still unbroken. The materials tested were iron of 47,000 lbs. per sq. in. tensile strength, and steel of 106,000 lbs. tensile strength.

Resistance to Unlimited Repetition of Bending.

	Fluctuation of Stress.	
Nature of Fluctuation.	Iron.	Steel.
Alternating	+ 17,000 – 17,000	+ 29,000 – 29,000
Load wholly removed.	+ 31,000 – 0	+ 50,000 – 0
Load partially removed	+ 45,000 – 25,000	+ 83,000 – 36,500

Any greater fluctuations with the given maximum stress, or any greater maximum stress with the given fluctuations, produced fracture.

Tests made by Mr. Joseph V. Stummer, of the Northern Railway of France, showed that steel axles subjected to a drop test sustained blows aggregating 1,000,000 ft.-lbs. before breaking, while iron axles bore only from 500,000 to 350,000 ft.-lbs. Steel axles showed double the tensile strength as compared with iron, and the same weight falling the same height only produced half the deflection in the steel axle.

The author then presented tests made by himself to show the difference in physical qualities of commercial wrought iron and soft steel in 4-in. square billets. He cut off sections of each billet after every pass through the rolls in the process of manufacturing a splice-bar. There were eight of these sections for each metal, and these sixteen sections were all etched at the same time and under the same conditions in the same bath, and full-sized prints were made from them. These prints are given in the paper, and very clearly show the difference in physical structure in the iron and in the steel; the iron showing the consecutive arrangement of the fibers and the steel a uniform homogenious structure.

Tables are given showing the elongation and reduction in area of ¾-in. round iron, ¾-in. round medium steel and of wrought iron P. H. R. splice-bars. The ¾-in. soft steel is about 24.3% stronger than the ¾-in. round iron, and is 28.3% stronger than the wrought iron in the shape of a splice-bar. And the ¾-in. steel is better by 17% in elongation and 38% in reduction of area than the iron. Mr. Pomeroy notes experiments made upon axles at the Crewe Works, in England, for determining the relative powers of resistance of iron and steel. With a bearing 4½ ins. in diameter, a 60-lb. weight was made to repeatedly fall 5 ft. on the top of the outside ring of the axle. The iron axle was cracked at the 6,128th blow, but actual breakage occurred at the 9,843d blow. A steel axle of the same dimensions stood 50,000 similar blows, and finally broke after 3,040 more blows with a 10-ft. fall. Various other tests follow, tending to show similar results.

Mr. Pomeroy then quotes from the excellent article of Mr. Kreuezpointer, in the "Iron Age," concerning the causes which tend to make steel show less favorable results in daily service than would be expected from the results of physical tests, and thus account for existing prejudices against the use of steel in axles. Prominent among these are want of proper mechanical treatment and the punishment axles receive in ordinary forging from the effect of unequal heating and working. In axles thus maltreated a difference in strength of from 4,000 to 7,000 lbs. per sq. in. and 10% in elongation may be found within a distance of 2 ins. Steel in the ingot is coarsely crystalline in structure, and subsequent hammering and heating break up these crystals and produce a fine "grain." This being the case, if more or less heat or work is bestowed upon one part of an axle than upon another, it is easy to understand that there would be a difference in structure, and therefore in strength in different parts of the same axle. But no object in steel, whether cast, rolled, or hammered, is finished or cooled with such uniform pressure or heat as to insure perfect equilibrium of the molecules in every part of the structure, and annealing after completion is therefore necessary. Safety thus means good initial material and work, careful manipulation and cost, for all this cannot be secured without spending money.

The author then refers to the experiments of the Russian Chernoff as indicating "the cure" for the ills complained of. Chernoff says that steel cast and allowed to cool quietly assumes a crystalline structure. If such an ingot is heated to bright red and allowed to cool without working in any way, it will be found, on breaking, that the structure has been altered, with a variation depending directly upon the quality of the contained carbon. In describing the action of steel under heat Chernoff uses the following nomenclature:

a = dark cherry red.
b = red, but not sparkling.
c = melting point.

He goes on to say that steel, however high its percentage of carbon, will not harden if heated to a temperature lower than a, however quickly it is cooled; on the contrary, it will be sensibly softer and more easily worked with a file. And steel heated to a lower temperature than b does not change its structure, whether cooled quickly or slowly. As soon as the temperature reaches the point b, the substance of steel quickly passes from the granular (or crystalline) to the amorphous (wax-like) structure, which it retains to the melting point, that is, to the point, c. In this condition steel is incompressible, and at the same time has an analogy to an exceedingly concentrated solution of strongly crystalline salt. If a piece of alum is put into a beaker and carefully heated, it will appear damp at a certain temperature, with separate crystals forming, and it will finally melt and form a solution of the crystals of alum in their own waters of crystallization. If this fluid mass is allowed to cool, it will again crystallize, and, according to the conditions under which it cools, any quality of crystal can be obtained. If allowed to cool slowly, in perfect quiet, the crystals will be large, regular, and symmetrically developed; but if the liquid is kept in constant agitation while cooling, the crystals will be very small.

The same change takes place in steel heated above point b. The higher steel is heated, the softer it becomes; the greater, therefore, is the liberty its particles possess to group themselves into crystals, and the slower the temperature is allowed to fall to the point b, the more time they have for the purpose. Below b, the structure of the mass does not alter. In this case the action of the carbon on iron may be likened to that of the water of crystallization on its salt; that is, it may be supposed that carbon at the temperature b begins to dissolve iron. This hypothesis is confirmed by the process of cementation, in which the iron must be heated above a certain temperature, or no effect will be produced, no matter how long the bars remain in contact with the carbon. It is very possible that the temperature at which the carbon begins to be absorbed in cementation is very near the point b

Mr. Pomeroy closed by saying that the practical utilization of the foregoing principles in a commercial way is due to the late John Coffin, who established the process bearing his name, now owned and used by the Cambria Iron Company. In this the toughening process begins with the best initial material—open-hearth steel. This metal is carefully formed and worked, afterwards relieved from the forging strains of unequal heat and work, and the product is a uniform and toughened structure, which means safety and increased wear.

Mr. Fuller, in discussing this paper, said that in three years' experience with steel axles, with very heavy weights imposed, he found the wear on the steel greater than the wear on iron, though he had fewer steel axles break than iron axles. The same class of metal was used in both, but he thought that with an iron axle a closer-grained bearing metal could be used than with steel. Mr. Pomeroy thought this could be explained by the fact that five years ago steel axles were used with a much lower tensile strength than at present. Since this strength has been increased from 72,000 lbs. to about 88,000 lbs. per sq. in., they are made a little harder without sacrificing any of the qualities of strength, and the result is a better journal and better service. Mr. Fuller explained that his remarks applied entirely to driving axles; and that he thought there was less wear with a steel than an iron crank-pin. He found that brass metal was better than bronze on steel axles.

THE COTTON STATES AND INTERNATIONAL EXPOSITION.

The next international exhibition in this country will be the Cotton States and International Exposition, which will be held at Atlanta, Ga., from Sept. 18 to Dec. 31, 1895. The principal purpose will be to exhibit the agricultural, mineral, and manufacturing resources of the South, and the enterprise has received the indorsement of the government, Congress having appropriated $200,000 for a building and exhibit, while considerable interest has been shown by state legislatures and foreign countries. The site is at Piedmont Park, which has an area of 190 acres, and is two miles from the center of the city; $300,000 have been expended on improvements, landscape work, artificial lakes, etc., and $150,000 more will be spent on this work. The estimates call for an expenditure of over $2,000,000, and the financial resources are as follows:

Local subscriptions	$225,000
City appropriation	75,000
Space (estimated)	100,000
Bonds	300,000
Gate receipts over bonds (estimated)	1,000,000
Light, power, etc.	25,000
Concessions	200,000
	$1,945,000
Grounds and improvements	262,000
Total	$2,207,000

The main buildings and their dimensions are given below, but in addition there will be a number of smaller and special buildings:

United States Government	180 × 260 ft.
Manufactures and Liberal Arts	216 × 370 "
Machinery	100 × 500 "
Minerals and Forestry	80 × 220 "
Agriculture	150 × 300 "
Electricity	91 × 250 "
Transportation	126 × 413 "
Woman's	124 × 134 "
Fine Arts	100 × 245 "
Negro	100 × 300 "

The buildings will be constructed of Georgia pine, with combination roof trusses, and the exterior will be covered with clapboarding to a height of 10 ft. above the ground, and the upper part covered with shingles. The supervising architect is Mr. Bradford L. Gilbert, of New York city, whose plans were accepted for all but two of the main buildings, Mr. W. T. Downing, of Atlanta, being the architect of the Fine Arts Building, and Miss Elise Mercur, of Pittsburg, Pa., architect of the Woman's Building. The plans for the Government Building were prepared in the office of the Supervising Architect of the Treasury Department, at Washington, and Mr. Bruce, architect, of Atlanta, is in charge of the construction of this building. Work has been commenced on the erection of several of the buildings. Mr. Grant Wilkins is Chief of Construction in charge of the buildings, electric lighting, and all similar work.

The Government Building is of Romanesque design, with main dimensions 180 × 260 ft., having a projecting pavilion 10 × 60 ft. on each side, and a tower 25 ft. in diameter at each corner, the height to the roof being 62 ft., and to the top of the central turret 105 ft. The entrance arches are 25 ft. wide and 20 ft. high, and the total floor space is 50,000 sq. ft. The Manufactures and Liberal Arts Building is 90 ft. high, and has a tower 60 ft. square at each corner, the total floor space being 103,000 sq. ft. Machinery Hall has 96,500 sq. ft. of floor; Minerals and Forestry, 26,000 sq. ft.; the Agricultural Building, 44,000 sq. ft., with a dome 100 ft. high.; Electricity Building, 19,500 sq. ft.

A special water-supply system and pumping plant are to be established, and the steam power plant will probably aggregate over 5,000 HP. The electric light plant will be of 3,000 HP., supplying current for 829 arc lamps and 10,700 incandescent lamps, as follows: 465 arc lamps placed 100 ft. apart in the grounds, 236 arc lamps 50 ft. apart in the buildings, 128 arc lamps on the "Terraces" or amusement grounds, 10,700 incandescent lamps in the buildings and for decorations on the outside of buildings, through the grounds and around the edge of the lake. The exhibition grounds are reached by the Southern Railway and several electric railways, and the maximum carrying capacity is estimated at 21,000 passengers per hour. An intramural railway will afford transit facilities about the grounds. The price of admission will be 50 cts.

The city of Atlanta is situated about 1,100 ft. above sea level, and has a population of about 100,000. It has good water supply and sewerage systems, electric light and gas, granite and asphalt street pavements, with brick and stone sidewalks, and has over 100 miles of electric railway. The hotel and boarding house accommodation is being largely increased to provide for the influx of visitors. The city is an important railway center, being entered by about ten lines of railway, affording direct and easy communication with all parts of the country.

The general classification of the exhibits is as follows: A, Minerals and Forestry; B, Agriculture and Food; C, Horticulture, Floriculture, etc.; D, Machinery; E, Manufactures; F, Electricity; G, Fine Arts; H, Liberal Arts; J, Live Stock; K, Transportation. Special rates for exhibits will be made by the railways, and foreign exhibits will be admitted free of duty if unsold, being in bond at the exhibition. All information may be obtained from Mr. Charles A. Collier, of Atlanta, the President and Director-General of the Exhibition.

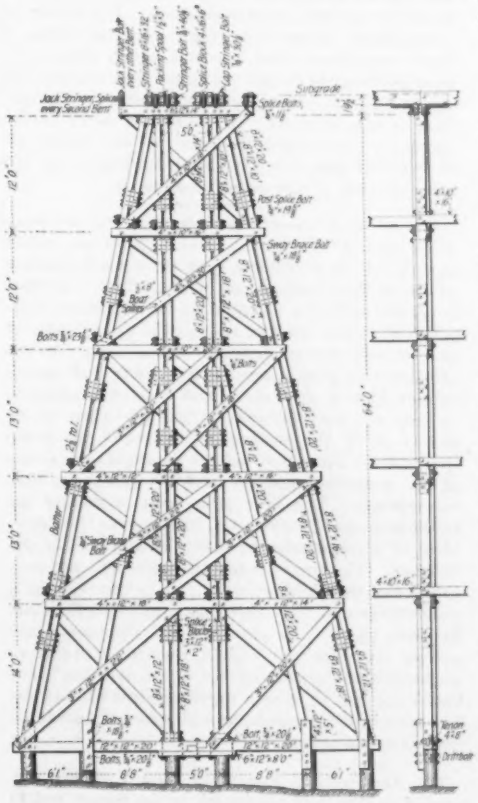
FALL OF TRESTLE IN ERECTION ON THE TORONTO, HAMILTON & BUFFALO RY.

A very common defect in the construction of timber trestles is the lack of sufficient longitudinal bracing between the bents, while, in not a few cases, this bracing is omitted altogether, even on long trestles, and several accidents have resulted from the collapse of such structures. We illustrate this week a trestle which failed during erection from the lack of sufficient longitudinal bracing, the bents falling like a pack of cards. The trestle was being built to carry the Toronto, Hamilton & Buffalo Ry. over Binkley's Hollow, about three miles west of Hamilton, Ont. (incorrectly reported in our issue of Jan. 17 as being on the Grand Trunk Ry.), and the failure occurred Jan. 9. For the following particulars, as well as the blueprints from which the accompanying cuts are made, we are indebted to Mr. E. B. Wingate, Chief Engineer of the railway:

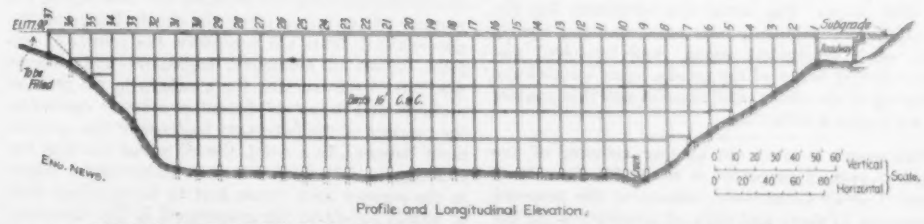
The erection of the trestle was commenced at bent No. 2, following with bents Nos. 3, 4, etc., until reaching No. 23, which was being raised at the time from the top of bents Nos. 22 and 21, over which the guys were carried and anchored to the pile heads of bent No. 17. The bent was first framed complete, with the exception of the inside batter posts, lying with its top to the west, and was raised with lifting lines by two hitches of the line, one at the top and the other a little above the middle of the bent. The first 22 bents had been raised in this manner without any trouble whatever, and while No. 23 was being raised and the top was about 15 ft. above the ground, it seems, so far as I have been able to ascertain, that something gave way between bents Nos. 6 and 7 (presumably a lack of necessary longitudinal ties being secured, which ties were being arranged or changed at the time), and the whole 16 bents fell gradually together, one on top of the other and on No. 23, the bents falling towards the west. Two men were seriously hurt, but are doing well, and are now out of danger.

The J. B. Donnelly Contracting Co. was the contractor, and wholly responsible for the erection until completion, and is the loser. Although the loss was very much over-estimated at first, I find now it only amounts to about $1,200. The timber in the structure is of the first quality white pine, from the Michigan pineries, with stringers 32 ft. long breaking joints, and the floor system consisting of 12-ft. white oak ties, spaced 4 ins. apart, or 12 ins. c. to c. The piling was of white oak, 30 ft. long, with butts from 18 to 22 ins. diameter, pointed and driven through hard, dry bottom land practically to refusal, with a hammer weighing 2,600 lbs. falling 25 ft. It is intended to build an arch culvert for the water-course at this point, and to fill the trestle during the present year, and for the filling to use the excavated material from the double-track tunnel and approaches which the company expects to build in the city of Hamilton.

The trestle bents are of substantial design, with ample sway bracing, and the drawings provide for four lines of horizontal timbers or purlins fastened to the batter posts, but for a structure of this size it would seem that diagonal longitudinal bracing should most certainly have been provided, and the contractor, as the sequel proves, would have consulted his own interests by putting on this bracing as fast as the bents were erected. The expense for such bracing would have added but a trifle to the cost of the structure, while greatly increasing its stability.



Side and End Elevations of Bent 23.



Profile and Longitudinal Elevation.

TRESTLE AT BINKLEY'S HOLLOW; TORONTO, HAMILTON & BUFFALO RY.

SMALL-CALIBER RIFLES.

In the last issue of "Notes on the Year's Naval Progress," by the Office of Naval Intelligence, at Washington, Lieut. Lincoln Karmany, U. S. Marine Corps, gives the reasons governing the adoption of the 6 mm. or .236-in. caliber for small arms, used in the U. S. Navy and Marine Corps.

The introduction of the strong yet slow "smokeless" powders first made practicable the radical reduction of the caliber of infantry small arms, by almost doubling the old muzzle velocity. France led the way in this movement in 1886, and the United States caliber of 0.236 in. represents the most advanced step in this direction. The opinion of experts now is that until a heavier metal can be found at a moderate cost this latter caliber is the smallest that can be considered effective. A bullet much below this caliber could not be depended upon, even at a very high velocity, to stop a horse in a charge, nor would it give the required trajectory at long range.

To secure satisfactory ballistic results, a sectional density of at least 3,000 grains per sq. in. is aimed at. This demands that the 0.236-in. caliber bullet should be more than five calibers long; and the rapid twist and high velocity necessary to keep it end on in its flight subject the barrel to a high pressure which increases rapidly as the diameter is reduced. Although a lighter and thus shorter projectile of the same caliber and the same pressure would give a higher velocity and flatter trajectory at short range, the depth of the danger-zone and the penetration power decrease too rapidly as the range increases, and this long range power is of great importance in operations on land.

There is much difficulty in obtaining powder suitable for the smaller calibers. One powder which in the French rifle of .315-in. caliber gives an initial velocity of 2,099 ft. per second, with a maximum pressure of 34,135 lbs. per sq. in. in the barrel, will, with an 0.30-in. caliber, only give this velocity with a pressure of 45,543 lbs. Each caliber seems to demand its own peculiar powder; but experts believe this difficulty will soon be removed.

One of the great advantages of reduced caliber, aside from those mentioned, is the decreased weight of ammunition. For the 0.256-in. caliber, 200 cartridges with clips weigh only 10½ lbs., and for the 0.236-in. caliber the weight is still less. There is no saving, however, in the weight of the piece, as the walls have to be made thicker to withstand the greater strains.

For purposes of comparison, as regards ballistics and weight of ammunition, the various calibers now adopted and in use may be divided as follows, the old Springfield caliber being added:

Caliber.	Springfield, .45 in.	8 mm., 0.315 in.	7.65 mm., .301 in.	7 mm., 0.276 in.	6.5 mm., .256-in.
Initial velocity, ft.-sec.	1,390	1,800 to 2,070	1,970 to 2,140	2,300	2,300 to 2,400
Height of vertex of 550 yds., trajectory abv. line sight, ins.	132	59 to 57	57 to 55	42	40
Depth danger zone at 1,100 yds., height of target 5 ft. 7 ins., yds.	22	37	38	40	42
Depth danger zone, 2,200 yds.	..	8	8	8	8
Weight 200 cartridges, with clips, lbs.	20	13.6	12.6	11.5	10.5

In experimental firing the Navy 0.236-in. caliber has given an initial velocity of 2,450 ft. per second, an ordinate of 2.6 ft. at 500 yds. range, and it is expected that the 200 cartridges with clips will weigh only 9.8 lbs. The maximum continuous danger space for infantry standing 5 ft. 10 ins. high is 445 yds. for the 0.315-in. caliber, and 540 yds. for the 0.256-in., with a firing height of 4 ft. 10 ins. From the experimental firing, there is reason to expect that this danger space will be increased to 600 yds. by the 0.236-in. caliber. As regards penetration, the 0.315-in. bullet will go 21 ins. into beech wood at 15 yds., and the 0.256-in. bullet, 27 ins. The 0.236-in. bullet has penetrated 60 pine boards 1 in. thick. At 2,200 yds. the remaining velocities are 530 ft.-sec. for the 0.315-in. and 650 ft.-sec. for the 0.256-in. bullet.

The various nations using the calibers coming into the table given above are as follows, according to Lieutenant Karmany: Using the 8-mm. caliber Austria, Chili, Denmark, France, Peru, Portugal and Sweden. The 7.65 to 7.7-mm. caliber is used by Argentina, Belgium, England, Russia (7.62 mm.), Switzerland (7.5 mm.) and Turkey. The 7-mm. caliber is adopted by Spain, and Germany uses a 7.9-mm. caliber; Holland, Italy and Roumania use the 6.5-mm. caliber. Chili has reported favorably upon the 7-mm. bullet, Servia upon a 7.2-mm., Brazil upon a 7.5-mm., and Norway and Sweden upon a 6.5-mm. caliber.

Electric trolley road competition, within a radius of five miles of Philadelphia, has already compelled the Philadelphia & Reading R. R. Co. to make a concession in the price of its monthly tickets to Wayne Junction. The operation of trolley lines in Germantown and Chestnut Hill has also gradually reduced the receipts of the Pennsylvania lines, so much so that a number of the trains have been withdrawn. The trolley lines to Media, Darby, Chester and other points on the Philadelphia, Wilmington & Baltimore Division are also making themselves felt, and the operating officers of the Pennsylvania R. R. are now considering means of meeting this competition, either by generally reducing fares or by lessening the train service.

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ADVERTISING RATES: 20 cents per line agate measure. Want notices, special rates, see page 22. Rates for standing advertisements sent on request. Changes of advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements by Wednesday noon.

The bulletin on our outside cover this week announces an article on "Rules for a Bridge Works Drafting Room." Delay in receiving corrected proofs from its authors at the time expected has made it necessary to withhold publication of this article until our next issue.

That an editor's lot is not always a happy one, and that the editor of a technical journal has special trials of his own, was illustrated in our last issue in the article describing the proposed Lake Washington ship canal, at Seattle. Among the advantages of a fresh-water harbor at that point the protection of timber structures against the attack of the teredo was mentioned. The printer or the proofreader assumed that "tornado" was a better word, and it came back to the editor in that shape. The error was corrected; but the printing establishment, now understanding clearly that some destructive agent was intended, and never having heard of the teredo, again twisted the meaning of the editor, and transformed this gnawer of wood into a torpedo!

The report is given, in another column, of the board of experts appointed to advise the New York Rapid Transit Commission respecting the proposed alterations in route and plan of construction of the New York Rapid Transit Railway. Briefly summed up, it approves the changes in the plans adopted by the former commission which were recommended by Chief Engineer Parsons, and recommends certain changes in routes and extent of lines, which reduce the total estimated cost to some $38,000,000. An addition of 10% for terminals, shops, etc., brings the total cost to $42,000,000. The total length of the lines recommended is, in round numbers, 14 miles of subway and five miles of viaduct. The total trackage will be 46 miles of track in subway and 15 miles on viaducts. Perhaps the most notable change recommended is the use of Elm St., instead of Broadway, for the line from City Hall Park to 14th St., a change which reduces, by $3,700,000, the estimated cost, and removes the apprehensions which have been felt concerning injuries to foundations by the construction of the road in Broadway. The advantages of this change of route were fully explained in this journal some time ago; and it appears fortunate, indeed, that this change is to be made, not alone for the direct benefits, but for the vexatious delays and obstructions which would almost certainly be met if Broadway were adhered to. The reduction in the total estimated cost of the whole system, moreover, is most favorable to the success of the enterprise, and the city is certainly to be congratulated on the results of the work of this expert board.

The tower system of electric lighting is being put in at Austin, Tex., as a part of the municipal lighting plant. The adoption of this system is somewhat surprising after its abandonment at Detroit and disuse or disfavor in several other cities, and the fact that scarcely an electric lighting specification for some time past has called for towers, if, indeed, any have. The objections raised by some of those cities which tried towers were that it was impossible to distribute the light uniformly. Wherever there were buildings of much height or shade trees, these always cast intense shadows. The theory of tower lights seems to be that they will diffuse a light everywhere, like the sun, but it appears to be impracticable to put up lights high enough and strong enough to do this where there are obstructions to cast shadows. In addition, it seems hardly necessary or desirable to light "all out doors," although this may have its good features from the point of view of the police department.

We all have something to be thankful for some time, even the engineers, who at times are rather envious of the architects with their fixed schedule of prices for professional work. This reflection is called forth by a notice of an "architectural competition" which we find inserted in the columns of one of our contemporaries. This notice invites architects to present competitive plans and specifications "for a three-story and basement building, to cost not over $35,000." The plans are to be passed on by the prospective owners of the building, and the three best will be awarded cash prizes of the munificent amount of $150, $100, and $50, respectively. The first prize man, assuming the building to cost $35,000, will thus receive the equivalent of a commission of 0.45% on the cost of the building. The second and third men will get two-thirds and one-third as much, while the remaining competitors will have their plans and specifications for their pains. As an additional allurement, the person receiving the highest award is "to have preference of superintendence of construction"; but that there will be such a superintendent or that the first man in the competition will secure the position, there is no assurance.

The Architectural League of New York has forwarded to President Cleveland, to the Senate and to the House of Representatives, at Washington, a memorial commending the McKaig bill relating to the manner of procuring plans for the buildings of the government. This bill represents the results of the joint efforts of architects, legislators and experts who have been working for a reform in the present methods and the establishment of a better system in the conduct of the important business of this government bureau. In a word, the bill opens the way for enlisting in this work the best architectural talent in the country upon terms just to the architect and of untold benefit to the government in the character and appearance of the buildings to be erected for public use. The present system produces disgraceful and lamentable results, as every one knows; but they are such as might be expected as coming from the assistants of a $4,000 man, who could not afford to accept the position of Supervising Architect had he the experience and practice of a first-class architect. A comparison between the many beautiful buildings erected for individuals and those built for the government makes plain the weak points in the present system of outward design; and the rotten condition, faulty drainage and ventilation and bad general arrangement of many of the structures devoted to government use, point out the lack of study or experience in this direction, and the want of honest and competent supervision during erection. Our government is annually spending millions in the erection of public buildings, and one of the provinces of a wise government is to aid in the development of good taste and the appreciation of works of art among the masses. It certainly is not expected to handicap this development by fostering bad design and construction. From this point of view, only the foremost talent of the country should be responsible for the design of the buildings the government pays for, as is now the case in almost every country except our own. The excess in cost over the present bad practice would be exceedingly small as compared with the amount expended, and the improvement in architectural appearance, as well as in general convenience, would well repay any increase in cost. The present system has been long tried and has been found sorely wanting; and it is time for a change on the lines pointed out in this bill.

The specifications for the new water supply for Jersey City, noted in our last issue, contain a very unusual provision, which may deter any reliable parties from putting in bids unless it is modified in some particulars. An elaborate chemical standard of purity, given elsewhere in this issue, is laid down, and it is provided that the city will not pay for water that fails to come up to this standard, although the company will be obliged to continue the supply while the water is deficient in quality. The specifications state that the standard is one laid down by Prof. Peter T. Austen, of Brooklyn, but it is practically identical, except in three items, with an arbitrary standard laid down for purposes of general comparison in interpreting analyses by Prof. Victor C. Vaughan, of the Laboratory of Hygiene of the University of Michigan. The exceptions noted make the Jersey City standard much higher than the Michigan, the former allowing 17 parts of total residue, .8 part of earthy bases and 0.85 part of chlorine per 100,000, against 50, 20 and 1, plus or minus, for the latter. Most contractors will, doubtless, think the standard an arbitrary one, and the provisions as to forfeiture of payment when the water falls below the standard entirely unfair.

Whether or not the standard is universal and unfair when applied to supplies from new and unpolluted sources, there certainly has been a blunder on the part of some one in stipulating the same standard for purified Passaic River water. The gross pollution of this water is the cause for seeking a new supply. It, therefore, follows that the chlorine, especially, if not the nitrates and nitrites, must be high in this water and above the standard laid down, which, in fact, admits of no nitrites. The makers of mechanical filters specifically disclaim the reduction of chlorine, nitrates and nitrites in any significant quantities, so that an important group of bidders is thus excluded from competition. Ordinary sand filters can reduce nitrites, but it is one of their special functions to increase nitrates, and, like the mechanical filters, they have no effect upon chlorine. Therefore, both mechanical and sand filters are excluded from competition. The electrical purification of water, as tried at Brewster's, in the Croton watershed, adds slightly to the chlorine. This exhausts all the methods of water purification on a large scale ever put into practical use in this country.

Bacteria are not even mentioned in the specifications. Their removal would seem to be the greatest object to be attained in purifying the Passaic River water. If they could be properly reduced, doubtless, the whole of the chemical standard for purified water might be disregarded, excepting the portions relating to suspended matter.

It seems likely that the chemical standard was never intended by Professor Austen to refer to purified water, but that having furnished it for the new supplies, it was unthinkingly adopted for the other.

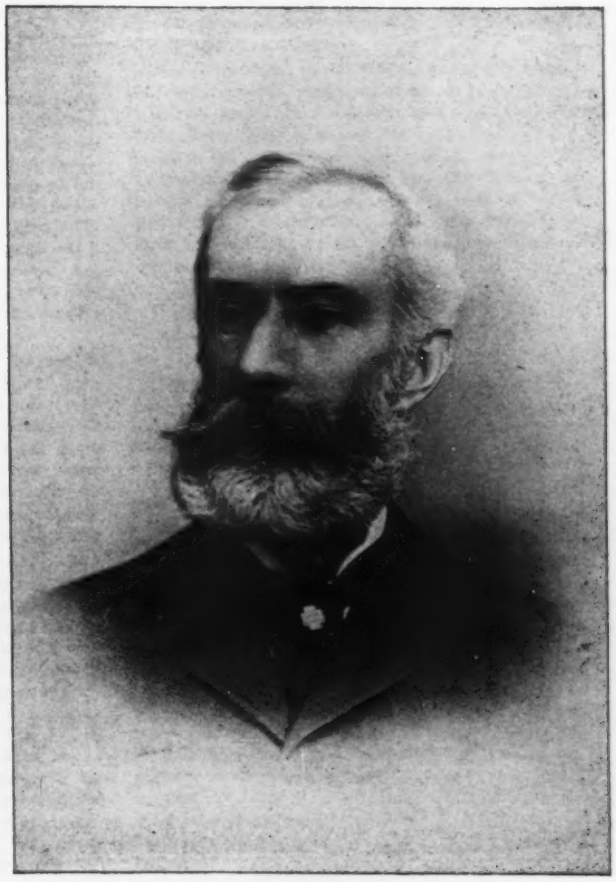
The comments in our last issue on the Jersey City specifications were written before the full official specifications had been made public, which explains their lack of reference to the above points.

THE WATER METER AS A SANITARY APPLIANCE.

One of the most popular arguments against the use of water meters, especially when the opponents wish to appear as disinterested and reasonable as possible, is that people will not use metered water in sufficient quantities to keep themselves in good health. The city council of Columbus, Ga., among other resolutions looking to a contract for water with the present or some new company, has adopted the following:

A restricted use of water is against public policy

Geo. S. Morison



Yours truly
C. F. C. Davis -

and against the public health, and inasmuch as it is thought that the willful waste of water can be prevented by the enforcement of police regulations, it is the sense of council that the public welfare is not best subserved by the use of water meters, and that such use should not be continued.

This resolution certainly shows more good sense on the subject than the average city council displays when dealing with the meter question, for it recognizes the existence of water waste, which should be prevented, and understands that some form of inspection is not only useful to that end, but also proper. As a matter of fact, some strong advocates of the use of meters do not believe in applying them to domestic consumers, as has been extensively done by the Columbus Water-Works Co., which in 1890 reported over 88% of the taps metered.

The valid objections to metering domestic supplies are based on the ground of inexpediency, rather than on any danger to health. With a reasonable amount of inspection, to prevent waste, the average water consumption per family is small; while, on the other hand, if quarterly or half-yearly bills are presented, the amount of labor involved in reading, recording, billing, collecting and receipting, makes an item in the expense account of considerable importance. So far as public health is concerned, practically nothing can be said against the use of meters, for the simple reason that the cost of water is so small that no saving of any amount can be made by even the most niggardly economy of water used for cleansing purposes. On the other hand, the waste of water from a leaky faucet or defective tank valve—things which a trifling bit of care on the part of the consumer will rectify—will be at once apparent in the water bill; and the consumer who neglects a leaky fixture, "because the leak is so small," will not repeat his neglect the second time.

The only remaining argument, from the health standpoint, is that a liberal use of water will keep soil pipes and sewers clean. But, as a matter of fact, any variation in the actual use of water will make little difference in the condition of soil pipes and sewers, and waste, by leaky fixtures, even though it reach large proportions, has practically no cleansing effect. As every engineer knows, a trickling stream has practically no flushing or cleansing power.

It may be urged, however, that meter rates prevent some people from putting in such sanitary fixtures as bath-tubs and water-closets; but, on the other hand, people who would practice such economies would certainly not introduce such fixtures if they were charged for at a fixed rate per year.

As a final answer to these objections to metering domestic supplies, it should be said that it is a common practice in well-managed water companies to charge a minimum flat rate where a meter is installed, fixed at such a point that the consumer will have no object whatever in stinting his use of water, while, on the other hand, the meter acts as a check to make him pay for its extravagant waste, through carelessness or defective fixtures.

The sooner municipalities and individuals recognize the real facts concerning water waste and its prevention, the sooner will our water-works officials be enabled to give better water pressures, to extend the distributing pipes to new sections and to improve the quality of the water, and all with a reduction in the present rates. Heavy waste often means deficient house and fire pressures, as is obvious to any engineer. It also often means that such funds as are avilable for extensions must be spent for larger pumps, reservoirs and mains, instead of for mains in previously unsupplied quarters, or for the improvement of the quality of the supply.

We note with interest that the Columbus council above referred to included among its resolutions the following:

> All water supplied to the city shall have been subjected to the most perfect filtration capable of being obtained by the use of the best and most approved methods of filtration known to science.

This is the true health measure for any city council to insist on; but how much easier to carry it out when the consumption is down to the lowest possible point, and how foolish to spend large sums in purifying water and then allow it to flow in a steady stream into the sewers from numberless leaky fixtures. Many cities in this country could readily filter the water which they actually use with no greater expenditure than now goes to pay for pumping water that flows to waste without doing any one a particle of good.

Again, with the expense due to water waste stopped, lower rates could be given to consumers, such as would place the public water supply within the reach of even the poorest classes. Thus the abandonment of dangerously-polluted wells could be brought about, and better plumbing could be afforded. That these improvements are in the direction of public health cannot be gainsaid; and experience of cities which have used the meter system for many years has demonstrated that by it waste can be reduced to smaller proportions than by any other means.

Thus it becomes obvious that, instead of being a detriment to the public health and welfare, as set forth or intimated in the opening quotation, the meter system would prove to be one of the greatest available aids to that end. And, after all, measuring water is only applying to it the method that is applied to almost every other measurable commodity that is sold.

It is often urged by unthinking political agitators that water should be as free as air or sunshine, but it is only under the most primitive conditions that water and air are to be had for the asking and only during a part of the day that sunlight is available for any one. Water, pure air and light have to be brought into most of our homes at some outlay in cash or its equivalent, and those who enjoy them ought, in fairness, to pay for these necessaries in the proportion that they use them.

LETTERS TO THE EDITOR.

HORSEPOWER REQUIRED TO PROPEL CARS.

Sir: Mr. Stone's acknowledgment of the typographical error contained in his train formula calls my attention to one in my own communication in your issue of Jan. 17. I see that I omitted the multiplication by W.S. of the last grade formula, which should read: HP. $= 0.00267\ (K + 20 \times \%)$ W.S.

I may add that I have checked these formulas, and find that they give correct results, and I think we are all indebted to Mr. Stone for making them known.

Yours truly, G.

Yonkers, N. Y., Jan. 25, 1895.

(The moral which the patient and long-suffering editor hopes all correspondents will draw from the above and other letters on the same subject is: When you write something which you hope to see in type, read it carefully over at least twice before you send it to the editor, and if you introduce any mathematical work, remember how it would please your worst enemy to find a blunder in it, and then check your work at least four times. In justice to "G.," we may say that he is, as a rule, among the most careful of our contributors, and we are, therefore, the more free to call attention to this matter in connection with his letter.—Ed.)

THE RENO SYSTEM OF TUNNELING FOR A RAPID TRANSIT RAILWAY.

Sir: In a letter published in your issue of Jan. 17 the writer outlined a method of tunnel construction which, in his opinion, would be free from objections inherent in other types of tunnel which have been proposed for rapid transit in New York city. The importance of the subject now leads him to enter into a more detailed description of the plan he has proposed.

Among the advantages claimed for the system are: (1) Small interference with the street surface. (2) The possibility of making certain desirable changes in the sewers contemporaneously with the construction of the tunnel walls. (3) A complete assurance that the foundations of buildings will not be injured nor require underpinning. (4) A further assurance that the cable road structure (which has cost $400,000 per mile) and the superimposed pipes and electric subways will not be disturbed. (5) Economy of cost.

Fig. 1 shows a typical cross-section of Broadway with the tunnel and small side sewers in process of construction. The method shown consists in building a concrete tunnel wall in a narrow trench on one side of the street, constructing the small sewer adjacent to it, then filling in and restoring the surface. The tunnel wall and sewer on the other side are then similarly constructed, after which there will be no further opening of the street. The subsequent operations consist in driving a "roof shield" resting upon the completed side walls, cutting out the now empty central sewer below the edge of the roof shield, removing the "core" of ground between the walls, erecting the columns and floor system of the upper tracks, and, finally, laying the concrete invert composing the tunnel floor.

In sinking the trenches for the tunnel walls it is proposed to use special steel sheet piles, which can be accurately driven down into the sand. Those forming the outside lining of the trench can be drawn up as the concrete filling proceeds, while the sheet piling on the inside of the trench will be recovered when the tunnel core is removed.

Above Union Square, where the lower half of the tunnel will be in rock, "channeling" machines could be advantageously applied to cut the rock core free from the inside line of the side wall, and so permit of its being removed later by small blasting charges.

In Fig. 2 the form of tunnel roof proposed is shown, and also in connection therewith, a view (looking up) of the under side of the roof shield described by the writer in Eng. News, Feb. 27, 1892. This roof shield is practically a circular shield rolled out flat and suitably trussed to support the weight of ground above it. The "sections" composing the tunnel roof consist, as shown, of pairs of channel beams with a concrete filling between them, which is put in and allowed to harden before the roof sections are brought to the tunnel. These are inserted in the rear of the shield, and under its projecting hood in the same manner as the cast iron ring segments in circular shield driving, to which they bear a further resemblance, in that they offer the substantial backing necessary for the rams of the shield to press against. The upper surface of the "roof sections," before being put in place, will be covered with a ½-in. thick layer of asphalt, which, upon their being forced tightly together by the pressure of the rams, will form an impervious covering for the roof and a thorough protection against corrosion.

The advance of the roof shield would leave a vacant space over the roof sections the thickness of the hood (2 ins.), were it not that this space, as soon as formed, will be filled by quick-setting cement forced in as follows: The under side of the projecting hood of the shield will be provided with several inch-deep grooves, parallel with the axis of the tunnel and extending to its rear edge. Into these grooves pipes will be inserted connecting with the usual "grouting" tank, where a pressure of 30 lbs. per sq. in. will force the cement into the vacant space before described and hold the material until it has set. Each of the pipes inserted in the grooves will be provided with a stop-cock, so that when the advance stroke of the shield is finished they may be discontinued from the grouting tank without reducing the pressure of the cement in the vacant space until the 30 minutes required for it to set have passed. When this has occurred the pipes will be withdrawn from the grooves, cleaned and prepared for the next stroke of the shield.

After this work is completed, if any question arises as to the existence of the 2-in. thick layer of cement as described, a test core can be easily taken out for examination by boring up at any point through the small concrete arches which form part of the tunnel roof.

The columns supporting the center of the roof are spaced 8 ft. apart, as shown in Fig. 2, so that the inner end of each roof section, for this distance, will need to be held up by a temporary support. One of several ways to accomplish this would be to place under each section an adjustable steel post extending down, through the trench shown in Fig. 1, to the concrete foundations provided for the columns. By this construction there would be no chance for settlement of the roof and ample space would be left between the two lines of temporary posts for erecting the permanent columns and the longitudinal girder connecting their tops.

The concrete foundation for the central columns will be laid in the bottom of a drift (shown in dotted lines, Fig. 1), which would be kept two weeks in advance of operations at the roof shield, but following the completion of the tunnel walls. The object of this advance drift is to permit the concrete to thoroughly harden before being subjected to the weight upon the columns. The final operation of removing the remaining core of the tunnel and laying the rest of the concrete floor or invert needs no classification except to say that while this is going on, all material and supplies can be handled upon the upper tracks.

In Fig. 1 a temporary superstructure is shown above the side wall and sewer trench, the purpose of which is to facilitate the handling of excavated material and supplies without blocking Broadway. In this manner all materials may be loaded and discharged at the

nearest side street. Furthermore, in addition to furnishing desirable protection for the trenching operations going on below, it will offer a solid support from which the electric subway may be hung during the construction of the small sewer beneath it.

It is true that Broadway is a street under which no experiments should be tried, but the writer is confident that those of his brother engineers skilled in the art of tunnelling will agree with him that the plan herein described follows engineering precedent so closely as to preclude applying the term experimental to any of its operations.

J. W. Reno, E. M.

Mills Building, New York city, Jan. 28, 1895

MOVEMENT OF WATER OVER A DAM WITH WIDE HORIZONTAL TOP.

Sir: My attention was recently called to the flow of water over wide-crested weirs, and in referring to the literature of the subject I find in Engineering

$$Q = \tfrac{2}{3}\, h' \sqrt{2\, g\, \frac{h'}{3}} = 3.00\, h' \sqrt{h'},$$

which he stated was published for the first time.

Before commenting on the correctness of the formula, I would say that it is by no means new, and may be found in the ninth edition of the "Encyclopedia Britannica" under the article on Hydromechanics. No authority is there given for it, but I believe it to be identical with that of M. Bolleau, who applies a

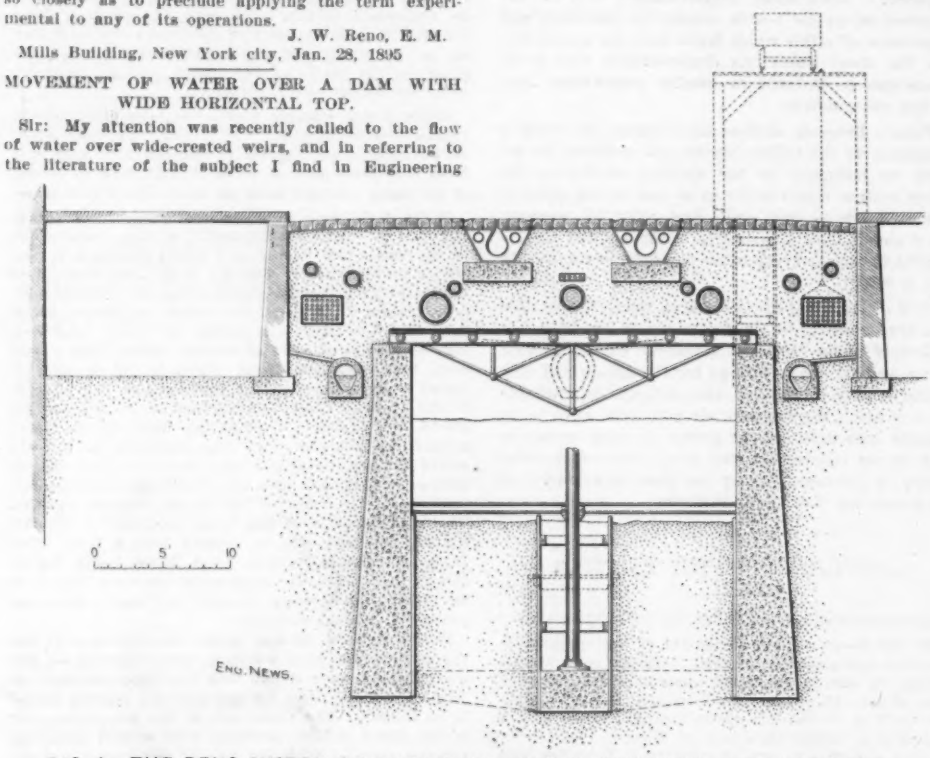
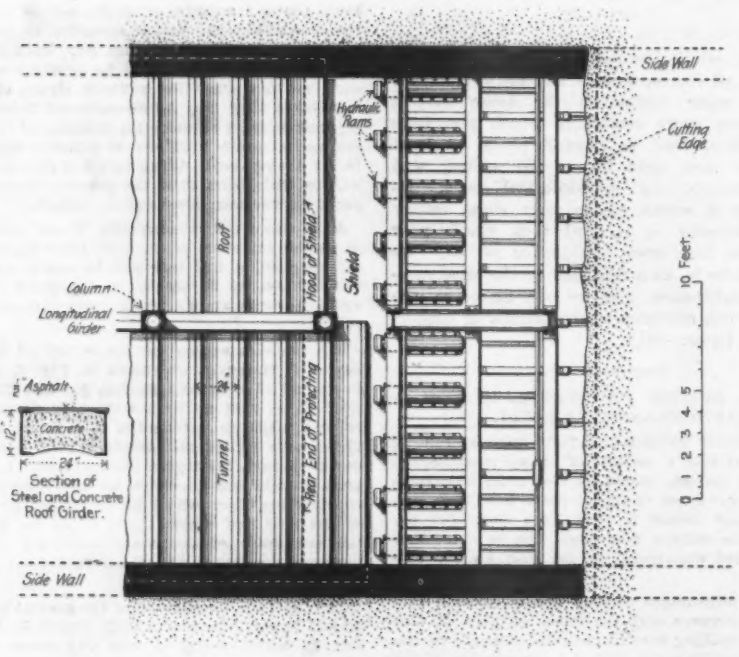


FIG. 1. THE RENO SYSTEM OF TUNNELING UNDER BROADWAY, NEW YORK CITY.



Plan of Tunnel Roof and Shield, Looking Upwards.

FIG. 2. THE RENO TUNNEL ROOF AND ROOF SHIELD FOR TUNNEL UNDER BROADWAY.

News of Sept. 29, 1892, an article by Mr. Jos. P. Frizell, M. Am. Soc. C. E., which was commented upon favorably in an editorial of the same issue.

Upon the assumption that all that produces velocity in a stream over a wide-crested dam is the loss of head, $h' - h$ (see accompanying diagram, Fig. 1, reproduced from above-named issue of your journal), Mr. Frizell derives by reasoning, which appears to be correct, a formula in which the head, $h = \frac{2}{3} h'$, and the following formula for discharge:

similar reasoning to the flow over standard weirs. I have no copy of his "Traite de la Mesure des Eaux Courantes" at hand, and cannot therefore be positive of this.

Regarding the formula itself, it should be noted that there is no known equation for the curve assumed by the surface of a stream above the crest of a weir, and further that all the formulas for finding h from h' give results varying materially from that obtained so ingeniously by this formula.

This may not necessarily imply that it is not correct, but it would suggest the necessity of checking it by actual examples. The case of Cleggs Dam, Fig. 2, on the Cape Fear River, N. C., as given in Trautwine from measurements by Ellwood Morris, C.E., is to the point.

In this case the crest is level, 8 ft. 5 ins. wide, and the stream assumes the form shown by the diagram. Assuming that the loss of head, $h' - h$, is all that produces velocity, we have in this example a velocity due to a head of 9 ins., instead of 5 ins., as Mr. Frizell would have it.

Weisbach says that he believes the reasoning upon which this formula depends is incorrect, and it certainly does not seem to apply to the example cited.

It is to be regretted that more data are not available upon this subject; a series of observations of the value of $h' - h$ for varying depths on a wide-crested weir, where the volume is as great as in the Colorado River at Austin, Tex., for example, would be interesting in this connection.

To all intents this formula treats the stream over the weir as though in a channel, where the velocity is of course due to the difference in elevation between two points in the water surface, and I think the error lies in the assumption that there are no other forces tending to produce velocity in the rapid change of form a stream undergoes in passing over a dam.

If I am in error in this matter, I shall be glad to have some one set me right.

Very truly yours, Edward N. Pike.

Meriden, Conn., Oct. 9, 1894.

(The above communication was submitted to Mr. Frizell, who has replied as follows.—Ed.)

Sir: I submit the following comments on Mr. Pike's paper touching a formula proposed by me for the flow of water over a wide-crested weir.

Whether this formula originated with me or not is of slight consequence. The important question is as to its correctness. I was led to assert, with some confidence, that the formula was published in September, 1892, for the first time by the following circumstance: In 1889 a committee of the American Society of Civil Engineers was appointed for the purpose of investigating the failure of the South Fork dam. This committee consisted of Messrs. Jas. B. Francis, W. E. Worthen, M. J. Becker and A. Fteley. I was earnestly desired by the chairman to aid in the development of a formula for computing the flow over the wasteway of the dam, a task which, after much reflection, I was obliged, not without mortification, to confess my inability to perform. Later, when engaged on the Austin Dam, and in some controversy touching that work, this method of treating the question occurred to me. The formula would have been well adapted to the above use, and the fact that it was not known to any of the eminent gentlemen above named led me to suppose that it had never been published.

I presume these gentlemen never thought of looking in a cyclopedia for such information. Mr. Francis used to quote a saying of Von Humboldt, to the effect that a cyclopedia was a bridge for an ass; but this kind of literature has greatly changed since Von Humboldt's time.

The article Hydromechanics in the ninth edition of the "Encyclopedia Britannica" is signed with the initials W. C. U., which I take to designate W. Cawthorne Unwin. The paragraph on the subject in question being brief, I transcribe it entire, as follows:

Weir with a Broad Sloping Crest.—Suppose a weir formed with a broad crest, so shaped that the streams flowing over it have a movement sensibly rectilinear and uniform, Fig. 50 (Fig. 3, herewith.—Ed.). Let the inner edge be so rounded as to prevent a crest contraction. Consider a filament, a a', the point a being so far back from the weir that the velocity of approach is negligible. Let O O be the surface level in the reservoir, and let a be at a height, h'', below O O, and h' above a'. Let h be the distance from O O to the weir crest, and e the thickness of the stream upon it. Neglecting atmospheric pressure, which has no influence, the pressure at a is $G\, h''$ and at a' it is $G\, z$. If v be the velocity at a';

$$\frac{v^2}{2\, g} = h' + h'' - z = h - e,\ Q = b\, e \sqrt{2\, g\, (h - e)}.$$

Theory does not furnish a value for e, but $Q = o$, for $e = o$ and for $e = h$. Q, therefore, has a maximum for a value of e between o and h, obtained by equating $\frac{d\, Q}{d\, e}$ to 0. This gives $e = \frac{2}{3}\, h$, and, inserting this value, $Q = 0.385\, b\, h \sqrt{2\, g\, h}$, as a maximum value of the discharge with the conditions assigned. Experiment shows that the actual discharge is very approximately equal to this maximum.

In the above discussion I understand G to designate the specific weight of water, and b the breadth, or as we more commonly say "length," of the weir.

Professor Unwin's treatment of the matter does not appear to be entirely free from misconception. He appears to limit his conclusions to a sloping weir, "so shaped that the streams flowing over it have a movement sensibly rectilinear and uniform." In my view

the only slope necessary to realize this condition would be in a weir so wide as to amount to a channel of considerable length. In this case, to justify his conclusions, the channel should have a slope equal to the frictional loss of head. Again, he appears to be uncertain whether the maximum discharge determined

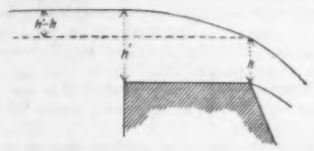


Fig. 1. Diagram Illustrating Movement of Water over a Dam with Wide Horizontal Top.

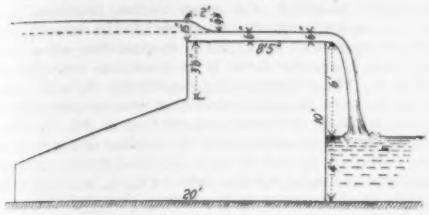


Fig. 2. Clegg's Dam, Cape Fear River.

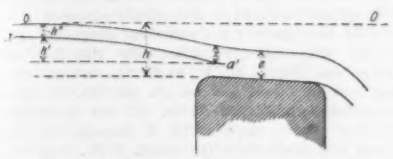


Fig. 3. Diagram Illustrating Flow over Weir with Rounded Crest.

Diagrams Illustrating the Flow of Water Over Weirs.

by the formula is the actual discharge passing the weir, with the assigned conditions. This is a case for the application of the principle of least action, a general law of physics developed by Euler, extended and perfected by Lagrange, viz.: Every result of the operation of natural forces is accomplished with the least possible expenditure of energy. Conversely, every definite expenditure of energy is attended with the greatest result that is possible under existing conditions. According to this law, the maximum discharge consistent with the conditions of the phenomenon, as deduced from the above reasoning, must be the actual discharge passing the weir.

As to the test of the formula by experiment, although I would like to see it applied to a wider range of facts, I think it stands the test of application very well so far as existing data permit. The article of Sept. 29, 1892, shows its application to results of experiments made with great care by Mr. James B. Francis. It overstates the quantities for the lower values of h by less than 4%, and for the higher values by only a fraction of 1%. This is as might be expected, since it takes no account of friction which has a greater influence in the former case than the latter.

As to the measurements cited by Mr. Pike in reference to a dam on the Cape Fear River, I can only say that I should want to be certain that these measurements were made with the same care and precision as those of Mr. Francis before admitting them to cast doubt upon a formula which accords so closely with results vouched for by that distinguished experimenter. Yours very truly, Jos. P. Frizell.

Boston, Oct. 17, 1894.

ON THE FLOW OF WATER OVER WEIRS WITH ROUNDED CRESTS.

Sir: If we observe the shape of a stream of water after leaving the crest of a weir it appears apparent that the different particles, owing to their curvilinear motion, must exert some pressure against each other and thereby retard the flow. To get a more definite understanding of this pressure we may consider the water between two sections, df and cg, Figs. 2, 3 and 4, these lines to be drawn at right angles to the streamlets or filaments composing the stream and so close together that the pressure against the two surfaces can be considered equal.

Let α = the average (inclination) angle the filaments form with the horizon;
r = the radius of the lower surface curve;
(dc) = cd = Δ = distance between sections on said curve.
V = velocity at a b;
p = weight of 1 cubic foot of water;
g = acceleration of gravity.
Other letters are as shown on Fig. 2.

The radius of the curve a b will then be very nearly $r_x = r + (h - x)\frac{1}{\cos\alpha}$; and the length a b nearly $= \frac{\Delta}{r}\left(r + (h-x)\frac{1}{\cos\alpha}\right)$. The centrifugal force acting on the filament at a b will then be $= \frac{p}{g} \times \frac{dx}{\cos\alpha} \times \frac{\Delta}{r}\left(r + (h-x)\frac{1}{\cos\alpha}\right) \times v^2 \times \frac{1}{r + (h-x)\frac{1}{\cos\alpha}} = \frac{p}{g}\frac{\Delta}{r\cos\alpha} \times v^2\,dx$. Let S = static pressure head at a b; then the theoretical velocity would be $= \sqrt{2g(x-s)}$.

The velocity of water flowing through a small opening in a thin vertical wall is hardly ever more than from 0.96 to 0.97 of the theoretical velocity, and I have therefore assumed

$$v = 0.95\sqrt{2g(x-s)};\ v^2 = 0.90 \times 2g(x-s) = 1.80\,g(x-s).$$

This substituted makes the centrifugal force $= \frac{p\,dx}{g\cos\alpha} \times \frac{\Delta v^2}{r} = \frac{1.80\,p\,dx\,\Delta(x-s)}{r\cos\alpha}$.

The combined centrifugal forces between d c and a b will be

$$\int_x^h \frac{1.80\,p \times \Delta \times (x-s)}{r\cos\alpha}\,dx = \frac{1.80\,p\,\Delta}{r\cos\alpha}\int_x^h (x-s)\,dx = \frac{1.80\,p\,\Delta}{r\cos\alpha}\left(\frac{(h^2-x^2)}{2} - \int_x^h S\,dx\right).$$

In the opposite direction we have the component of the weight a b c d $\times$ 1, or:

$$\frac{p\,(h-x)}{2\cos\alpha}\left(\Delta + \frac{\Delta}{r}(r + (h-x)\frac{1}{\cos\alpha}\right)\cos\alpha = \frac{(h-x)\,p \times \Delta}{2r}\left(2r + (h-x)\frac{1}{\cos\alpha}\right).$$

The difference is approximately the pressure exerted on

$$a\,b = p\,\delta x \times \Delta \times \frac{r + (h-x)\frac{1}{\cos\alpha}}{r}$$

or, $S = \frac{1}{r + (h-x)\frac{1}{\cos\alpha}}\left(\frac{1.80}{\cos\alpha}\left(\frac{h^2-x^2}{2} - \int_x^h S\,dx\right) - \frac{h-x}{2}\left(2r + (h-x)\frac{1}{\cos\alpha}\right)\right)$.

After reduction $S = \frac{1}{r\cos\alpha + (h-x)}\left[(h-x)(1.4x - (r\cos\alpha - 0.4h) - 1.80\int_x^h S\,dx\right]$

Over the crest we may say $\cos\alpha = 1$, and

$$S = \frac{1}{R + h - x}\left[(h-x)(1.4x - (R - 0.4H) - 1.80\int_0^H S\,dx\right]$$

The term $1.80\int_0^h S\,dx$ is comparatively small and may be ignored for first approximation; by substituting the value of S thus found a more correct value of s will be found.

For some assumed values of R, I have computed the accompanying table, in which M represents the area A B C D, Figs. 1, 2, 3 and 4, when H = 1.

A few of these results have been platted as shown by Figs. 1, 2, 3 and 4. The influence of the static head S is clearly shown.

A comparison with Fig. 5 will show how erroneous it is to assume $Q = Nx\,(2\text{-}3\,H\sqrt{H}\sqrt{2g} \times L)$, though for practical purposes a suitable value of 2-3 N = m may be used.

Let L = length of weir without end contraction;
Q = discharge in cubic feet per second.

Then $Q = 0.95\sqrt{2g}\int_E^H \sqrt{X-S}\,dx = 7.63\int_E^H \sqrt{X-S}\,dx = 7.63\,H\sqrt{H}\int_E^H \sqrt{\frac{X-S}{H}}\cdot\frac{dx}{H}$

The values

$$\int_E^H \sqrt{\frac{X-S}{H}}\cdot\frac{dx}{H} = m$$

as well as the values 7.63 m = M are found in the table.

The value of M is also platted in Fig. 6.

From this it will be seen that Q or M is a maximum for R = 0.5 H. The water will always form itself so that the greatest amount flows over the weir. The shape of the stream has been constructed as shown in Figs. 2, 3 and 4; from this the sine of slope over the crest has been found approximately and also platted in Fig. 6.

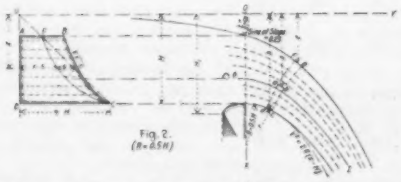


Fig. 2. (R=0.5H)

Fig. (R=0.2H)

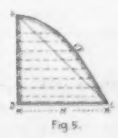


Fig. 5.

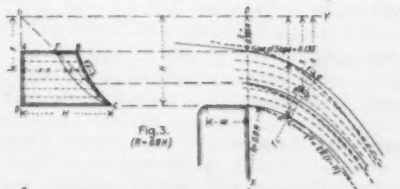
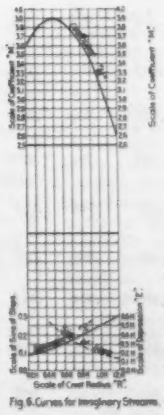


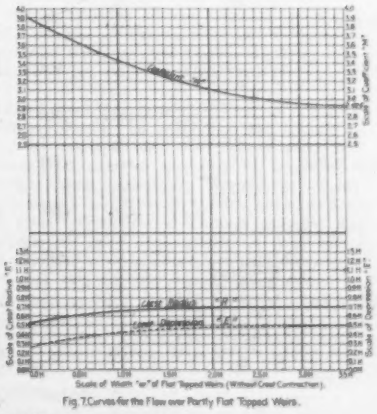
Fig. 3. (R=0.8H)



Scale of Coefficient "M"

Scale of Crest Radius "R"

Fig. 6. Curves for Imaginary Streams.



Scale of Coefficient "M"

Scale of Width "w" of Flat Topped Weirs (Without Crest Contraction).

Fig. 7. Curves for the Flow over Partly Flat Topped Weirs.

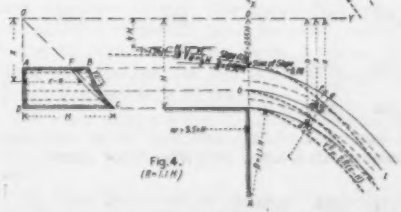


Fig. 4. (R=1.1H)

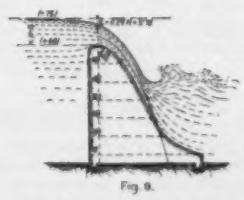


Fig. 8.

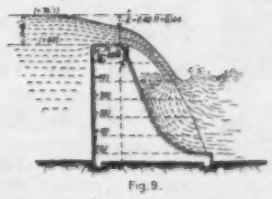


Fig. 9.

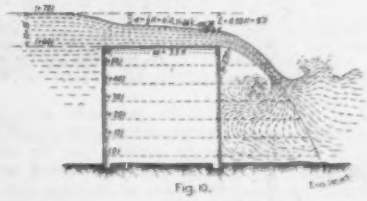


Fig. 10.

DIAGRAMS RELATING TO THE FLOW OF WATER OVER WEIRS. Prepared by N. Werenskiold, Dallas, Tex.

If we compare our result for the maximum flow with Francis' formula we have,

$$3.90\,H\sqrt{H} = 3.33\,H_1\sqrt{H_1}$$

$H_1 = 1.11$ H. The difference 0.11 H represents crest contraction.

If the top is partly straight and so wide that the

streams flowing over the same at any place are rectilinear and uniform, then we have the well-known rule for maximum flow in a canal, and may say

$$Q = 0.95 \times \frac{2}{3} H \sqrt{2g \times 1.5 \times H} = 2.925\, H \sqrt{H}$$

This will hardly take place for widths less than 3.5 H. In lack of experiments or anything at all bearing on the matter, we may assume

$Q = 3.90\, H\sqrt{H}$ for w = 0 and $Q = 2.925\, H \sqrt{H}$ for w = 3.5 H.

For intervening widths Q or M may be represented approximately by a curve as shown in Fig. 7; same is nearly horizontal for w = 3.5 H.

As far as I have seen, all writers seem to assume that the velocity over the weir at the depth x under the upper surface is $= \sqrt{2gx}$, that is if the velocity of approach is neglected, and that the theoretical discharge over the weir is $= L \int_0^H \sqrt{2gx} \times dx = \frac{2}{3} L \times H^{\frac{3}{2}} \sqrt{2g}$.

I have also seen it argued that the depression cuts no figure, but that the velocity is less than the theoretical. To make this agree with experiments, they have used a co-efficient of velocity and called the discharge: $M \frac{2}{3} L. H^{\frac{3}{2}} \sqrt{2g}$. I believe, and have attempted to show that it is principally the existing static head or reduction of the velocity head, together with the contraction, that causes the so-called theoretical discharge to differ so much from the actual.

In observing the discharge at the end of a flume I have noticed that the surface is gradually getting lower and more curved towards the end. As near as I can ascertain the same amount of water will pass through the different sections over a wide weir, Figs. 4 and 10, when

$$\frac{1}{re} = \frac{d^2e}{dy^2} = \frac{19.44}{H} \times \left(\frac{e - \frac{1}{3}H}{H}\right)^2$$

$$\tan a = \frac{de}{dy} = 3.6 \left(\frac{e - \frac{1}{3}H}{H}\right)^{\frac{3}{2}}$$

$$-y = \text{Const} - \frac{H}{1.8}\sqrt{\frac{H}{e - \frac{1}{3}H}} = 1.36\, H - \frac{H}{1.8}\sqrt{\frac{H}{e - \frac{1}{3}H}}$$

This indicates that the surface has a considerable slope over the crest. The downward direction of the upper part of the stream when leaving the weir must necessarily diminish the crest radius, increase the static pressure head, S, and diminish the velocity, so a larger area will be required to pass the same volume than when the slope is as small, as represented in Fig. 6. The corresponding depression, E, and crest radius, R, have been determined as near as practicable for the modified condition and platted in Fig. 7. The probable shape of the stream on leaving the weir has been indicated by dotted lines in Figs. 3 and 4. The conditions indicated by the table, Fig. 6, and the full lines in Figs. 3 and 4 may possibly exist by very favorably formed sluice openings.

If for some reason it is desirable to form the down-stream face of the dam so that the stream glides over same without pressure, then the simple equation $y^2 = 2\,R\,(x - H)$ may answer all practical purposes. The influence of the shape of the weir will be better shown by Figs. 8, 9 and 10, which represents a flow of about 225 cu. ft. per lin. ft. passing over differently shaped dams. At the up-stream edge, or near same, in Fig. 10, I suppose all filaments have the same velocity head, 6 ft., and that the velocity is the same at the various depths, thus, we may say, $Q = 12 \sqrt{2gx \times 6} = 236$. At the lower edge some assume that the velocity should be the same at various depths. I venture the opinion that the law governing the nearly free discharge of the various streamlets under different heads is different. Ignoring the static pressure existing between the streamlets at the edge, I suppose, or assume, that as the undoubtedly existing curvature increases, the centrifugal force comes more and more into play until the stream's weight is equal to the centrifugal force (near the edge). I therefore believe that the surface velocity will be $\sqrt{2g \times 9}$ and the velocity at the crest nearly $\sqrt{2g \times 18}$, not $\sqrt{2g \times 9}$, since there is little pressure from the overlying water, and should say

$$Q = \int_9^{18} \sqrt{2gx}\, dx = \left[\frac{2}{3} \times \sqrt{2g}\right]_9^{18} = 274.$$

Taking the internal static pressures in consideration, it would probably be 236 in place of 274 cu. ft.

If the discharge had been in 9 ft. of water in place of the air I believe it would have been right, or nearly so, to say $Q = 9 \sqrt{2g \times 9} = 217$.

When I consider how eminent hydraulicians have erred, I hope you will pardon me if I am in error, and that I may not be assuming too much in writing at such length.

The Austrian engineer, Gustav Ritter von Wex, has made use of pretty nearly all the weir experiments ever made and has succeeded in deducing half-theoretical and half-empirical formulas which conform remarkably well with all experiments. He covers nearly all cases of weirs with sharp edges, but has practically nothing of value as regards rounded weirs.

Very respectfully, N. Werenskiold.

Dallas, Tex., Oct. 3, 1894.

Sir: The following is submitted in answer to your request for my views upon the paper of Mr. N. Werenskiold, who is known to me as a gentleman of superior attainments. I am glad to see him giving his attention to problems of this kind, which, I doubt not, he will in time become master of. In the present instance he will, I am convinced, receive in entire good nature my criticism, which must, in some points, be adverse.

We will consider his first proposition:

If we observe the shape of a stream of water after leaving the crest of a weir, it appears apparent that the different particles, owing to their curvilinear motion, must exert some pressure against each other and thereby retard the flow."

This appears to me to be contrary to one of the fundamental laws of motion.* The mass of water under discussion is a system of small bodies (particles) in

* The momentum of a system of bodies in motion cannot be altered by mutual actions between the bodies themselves.—Rankine, Applied Mechanics, p. 505.

TABLE SHOWING VALUES OF STATIC HEAD, S, AND AREA A B C D = M (SEE FIGS. 1, 2, 3 AND 4). FOR CORRESPONDING CREST RADII, R, AND DEPRESSIONS, E.

$\frac{R}{H}$	$\frac{E}{H}$		$\frac{X}{H}$ = 0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	$m = \int_H^0 \sqrt{\frac{X-S}{H}} \cdot \frac{dx}{H}$ E	$M = 0.95\, m \sqrt{2g}$
		$\frac{S}{H}$	.029	.101	.172	.249	.306	.364	.431	.374	0.00	0.	
0.2	0.16	$\frac{X-S}{H}$	.171	.199	.228	.260	.294	.336	.399	.526	1.00		
		$\sqrt{\frac{X-S}{H}}$	.414	.446	.477	.510	.542	.580	.632	.725	1.00	.469	3.58
		$\frac{S}{H}$	—.011	.055	.119	.177	.227	.262	.269	.214	0.00		
0.4	0.217	$\frac{X-S}{H}$	.....	.245	.281	.323	.373	.438	.531	.686	1.00		
		$\sqrt{\frac{X-S}{H}}$	.....	.495	.530	.568	.611	.662	.728	.828	1.00	.506	3.86
		$\frac{S}{H}$	.030	.030	.000	.144	.189	.218	.220	.168	0.00		
0.5	0.250	$\frac{X-S}{H}$	.....	.270	.310	.356	.411	.482	.580	.732	1.00		
		$\sqrt{\frac{X-S}{H}}$	.....	.520	.557	.597	.640	.694	.762	.856	1.00	512	3.90
		$\frac{S}{H}$	.....	.005	.062	.112	.153	.179	.180	.134	0.00		
0.6	0.291	$\frac{X-S}{H}$	.....	.295	.338	.388	.447	.521	.620	.766	1.00		
		$\sqrt{\frac{X-S}{H}}$	.....	.543	.581	.623	.669	.722	.787	.875	1.00	.508	3.87
		$\frac{S}{H}$	.....	—.020	.034	.082	.121	.145	.146	108	0.00		
0.7	0.337	$\frac{X-S}{H}$	.....	.....	.366	.418	.479	.555	.654	.792	1.00		
		$\sqrt{\frac{X-S}{H}}$	.....	.....	.605	.647	.692	.745	.809	.890	1 00	496	3.78
		$\frac{S}{H}$	.....	—.045	.008	.055	.092	.115	.118	.087	0 00		
0.8	0.385	$\frac{X-S}{H}$	.....	.....	.392	.443	.508	.583	.682	.813	1.00		
		$\sqrt{\frac{X-S}{H}}$	.....	.....	.626	.667	713	.765	.826	.902	1.00	.478	3.65
		$\frac{S}{H}$	.....	.....	.017	.030	.066	.089	.094	.070	0.00		
0.9	0.436	$\frac{X-S}{H}$	.....	.....	....	.470	.534	.611	.706	.880	1.00		
		$\sqrt{\frac{X-S}{H}}$	.....	.....	....	.686	.731	.782	.840	.911	1.00	.454	3.46
		$\frac{S}{H}$	.....	....	—.040	.005	.041	.065	.073	.035	0.00		
1.0	0.490	$\frac{X-S}{H}$	.....	.....	...	.495	.559	.635	.727	.845	1.00		
		$\sqrt{\frac{X-S}{H}}$	.....	.....	....	.704	.748	.797	.853	.920	1.00	.424	3.24
		$\frac{S}{H}$	.....	.....	....	—.017	.019	.044	.053	.044	0.00		
1.1	0.547	$\frac{X-S}{H}$	.....	.....	....	....	.581	.656	.747	.853	1.00		
		$\sqrt{\frac{X-S}{H}}$	.....	.....	....	....	.762	.810	.863	.923	1.00		
		$\frac{S}{H}$	.....	.....	....	.....	—.001	.026	.040	.033	0.00		
1.2	0.598	$\frac{X-S}{H}$	.....	.....	....	....	....	.674	.760	.867	1.00		
		$\sqrt{\frac{X-S}{H}}$	.....	.....	....	....	....	.821	.872	.931	1.00	.348	2.65

motion. The resultant momentum can be changed only by the operation of forces external to the system. These particles pass the crest of the sharp-edged weir with very different velocities. Mutual actions take place between them resulting in a loss of momentum by some and a gain of momentum by others, tending to uniformity of motion in the mass. The resultant momentum, and therefore the resultant velocity, remains unaffected by such mutual actions.

I must observe that I understand Mr. Werenskiold to be speaking in this place of a simple weir with a sharp crest, or of a stream which has passed a dam, and is moving freely under the action of gravity and acquired velocity. On this view, the assumption of a static head within the stream is clearly erroneous. No pressure other than that of the atmosphere can exist in the stream after it has passed the line O X, Fig. 2. Between the plane of the upstream face of the weir and the plane of O X a pressure exists. This is an incident of the phenomenon of contraction and results from the fact that the particles of water approach the crest from all directions between vertical and horizontal. The change of direction undergone by the several particles develops a centrifugal force which opposes the pressure of the head, H, and sustains the lower surface of the weir stream in its curved form. After passing the summit of the curve, all pressure ceases. To understand this point needs no further consideration than this: A head of water can have two effects; it can create a pressure or it can generate a velocity. In more comprehensive language, the energy of a head of water may be potential, which is the energy of position, or kinetic, which is the energy of velocity. It may be partly one and partly the other. As one of these effects increases the other must diminish. When the head is wholly applied to the creation of pressure there can be no velocity. When it is wholly applied to the generation of velocity there can be no pressure. In other words, neglecting mutual attractions, there can be no pressure between bodies moving without constraint under the action of gravity. Beyond the line O X, in Figs. 2, 3 and 4, the function of the head is exhausted in the generation of velocity, and it has no power to create pressure. Neither can any pressure be developed in this part of the stream by the direct action of gravity, for this tends to separate the particles and attenuate the stream.

This is a good place to advert to a natural misapprehension, viz., that the pressure due to the depth on the outer crest of a wide weir ought to have its effect in imparting velocity to the water, an idea which is traceable in the memoir of Mr. Werenskiold. Also in the communication of Mr. Pike (included in this issue. —Ed.) I find the writer's comprehension of the phenomenon obscured by the same misconception.

Making abstraction of the slight velocity with which the water moves in the pond, we may say that up to the point when its surface begins to curve in consequence of the proximity of the dam, its energy is wholly potential, and is equivalent to that of the total fall from the surface above the dam to the surface below, which we will call h. I need not stop here to show that this is true for each particle of water irrespective of its vertical position. Its total energy remains unchanged at all points of its path in passing the dam. At each point it has the kinetic energy due to the descent already accomplished and the potential energy due to the descent yet remaining. At the point to which E applies, each particle whose weight is G and velocity V has the kinetic energy

$$G\frac{v^2}{2g} = G\frac{\left(\sqrt{2gE}\right)^2}{2g} = GE$$

the potential energy G (h – E), and the total energy G h. Now, if we assume that the depth on the weir at E is instrumental in producing velocity, we are assigning to the water at that point a greater amount of energy than it possesses at other points and are making the sum of the parts greater than the whole.

The formula given by Mr. Werenskiold for a very wide weir is:

$$Q = 0.95 \times \frac{2}{3} H \sqrt{2g\frac{H}{3}} = \text{discharge per unit of length.}$$

This, it will be noticed, is the identical formula published by me in Engineering News of Sept. 29, 1892, except that it is here affected by the coefficient 0.95. That the introduction of this coefficient adds nothing to the correctness of the formula will appear from the comparison of its results with those of experiments given with its publication, as well as from my comments on the article of Mr. Pike.

The writer remarks: "The water will always form itself so that the greatest amount flows over the weir." This proposition is the basis of the formula referred to above, and, if it be true, then the horizontal velocity with which the water leaves the wide-crested weir, or which it has at the most contracted section of the stream coming from a contracted weir, must be that due to one-third of the depth. This adjustment between the velocity and cross-section of the issuing stream gives the maximum discharge, and this maximum is diminished by any derangement of this adjustment. This proposition is true irrespective of the form of the weir. Mr. Werenskiold's conclusions appear to be inconsistent with this principle in two points:

(1) He makes the depth of the stream at its exit from the wide-crested weir less than two-thirds the total depth, which is inconsistent with a maximum value of the discharge.

(2) The radius of curvature of the stream, at the point referred to, is a quantity dependent on two factors, viz., the velocity which, as we have seen, is independent of the form of the weir, and gravity, which is constant.

It is difficult to understand how this radius should have such widely divergent values as are assigned to it.

In the case of a weir of such width as to amount to a channel of considerable length, the depth of water at the exit can, of course, diminish to any extent by reason of the loss of head from friction.

Having considered the grounds of Mr. Werenskiold's method, let us advert to the application of it, in the case shown at Fig. 10. This represents a level-topped weir of considerable width, the upstream edge rounded sufficiently to avoid any loss of head from contraction. It is manifest from what precedes that the velocity of the water, at any point on the level part of the weir, friction not considered, cannot be greater or less than that due the descent of the surface at the same point. It is also manifest that the quantity of water passing any unit's length of the weir must be the same at all points in its path. By Mr. Werenskiold's figures we have at the point e

$$Q = 12\sqrt{2g \times 6} = 235.74 \text{ cu. ft. per sec.}$$

At the point E we have

$$Q = 9\sqrt{2g \times 9} = 216.54 \text{ cu. ft. per sec.}$$

It is unnecessary to pursue the subject further. A theory involving such incongruities must be defective.

Although a thorough mastery of modern analytical methods in mathematics is essential to original investigations in hydraulics, and although these branches have made great advances in recent years, they cannot yet be regarded as fully adequate to deal with the general problem of the flow of water. The simplest case of sharp-edged weirs and orifices presents insuperable analytical difficulties in the summation of the centrifugal force for the purpose of determining the extent to which the issuing stream is narrowed. A wide-topped weir, especially when the upstream edge is rounded, forms an exceptional and fortunate case of the general problem, in which the main difficulties are eliminated and the flow can be very closely determined upon the principle of least action.

J. P. Frizell.

Boston, Oct. 30, 1894.

THE BOARD OF EXPERTS' REPORT ON THE NEW YORK RAPID TRANSIT SYSTEM.

In our issue of Dec. 27 we published the report of Mr. W. B. Parsons, Chief Engineer to the New York Rapid Transit Commission, giving plans and estimates for the construction of the New York Rapid Transit Ry. Mr. Parsons' report and estimates were approved by Messrs. Alphonse Fteley and Theodore Cooper, Consulting Engineers. The commission submitted Mr. Parsons' report to a board of expert engineers, with a series of questions, and on Jan. 29 this board presented its report. We reprint it as follows:

The board organized Jan. 7, and entered upon the consideration of the questions submitted to them by the commission, which questions were based upon the fact that:

The report submitted by the chief engineer, with the concurrence of Messrs. Fteley and Cooper, shows that the cost of any system, if carried to the city line on both the east and west sides of the city, will exceed $50,000,000, which is the limit of expenditure named in the law creating this commission.

The first question is:

Whether the calculations as to the probable cost embodied in the report may be properly accepted by the commission as a basis for their conclusions.

Experience has proved that in underground work the actual cost often overruns the estimates. The engineer may endeavor to make his calculations of quantities and his assumed prices ample, and even high, but there are sure to be so many accidents and unforeseen complications and items which have been omitted that the estimate often proves inadequate. What we say of the uncertainty of cost is especially true of that portion of the work lying along Broadway below 14th St. We agree with your engineer in believing that the subway for local traffic will have, in most cases, to be made by opening deep trenches from the top, as any method of shallow tunnelling among the water pipes and sewers would be almost certain to result in slips and cavings, which would interrupt the street traffic and prove very costly. These deep trenches will have to be opened near the curbs, thus cutting off, for a time, access by vehicles to the adjoining sidewalks and stores, and would prove to be a serious interruption to business.

Taking all these things into account, your engineer has made his estimates accordingly, and these estimates have been gone over independently by the members of this board, who have arrived at a substantial agreement confirming them, so that this board of experts is prepared to say that these estimates may be accepted by the commission as reliable, and, in some respects, even liberal, but not too much so, in view of the unexpected contingencies which always occur in the execution of great enterprises.

The second question is:

Whether the board of experts concurs in believing the plan of construction in Broadway proposed by the former commission unsatisfactory, for the reason suggested by the chief engineer, or for any other reasons.

To this question the board of experts replies that it agrees with the chief engineer in his objections to the plan of construction proposed by the former commission, and that it is of opinion that the mode of construction suggested by the chief engineer is not only a great improvement upon the previous plan, but can be executed at much less cost.

We also entirely agree with him that a width of 44 ft. would be too narrow for the four tracks proposed on the same level; not only because of the risks to the inspectors and workmen, but because of the risks to the passengers from derailments or possible collisions, the trains will be following so close to each other, and the tunnel between the stations may be so dark, that even slight mishaps, of no particular consequence were the tracks in the open air and spaced at the usual distance, might result in causing great loss of life, and the blocking of traffic for hours. An ordinary four-track steam railroad would occupy a total width of about 54 ft. between side-walls in open cuts. It may perhaps be safe to reduce this in the proposed tunnel, but we deem that safety should not be endangered by adopting a less width than 50 ft., nor a height less than 13 ft.

The third question is:

Whether the plan submitted by the chief engineer of treating the local and express tracks as two roads, using the same stations when they join, appears to them to be practicable and wise.

To this question the board of experts replies that it has carefully examined the plans of the chief engineer above referred to, and they appear to the board of experts to be practicable and wise. We are thoroughly satisfied that the proposed plan to separate the express tracks from the local tracks on Broadway, except at the stations, will greatly diminish the chance of accidents, and will much simplify the process of construction, as well as permit better gradients. It also admits of the construction of two of the tracks without building the other two till later, if desirable. We look upon this suggestion of the separation of the local from the express tracks on portions of the route as a valuable one, and we recommend that the commission shall have the original plans modified accordingly.

We understand that the plans submitted by the engineer are general plans. In preparing the details of construction, we suggest that the tunnel walls and arch roof proposed can be modified so as to give greater strength, with probably a diminution of cost, by adopting concrete masonry lined with brick, and reinforced by steel beams buried in the concrete, and perfectly protected from rust thereby. We would also suggest that the sewers should not be joined to, or form an integral part of, the subway structure.

The fourth question is:

Whether the board of experts can suggest any better solution of the problem before the commission, either as to route or construction, than has already been brought forward.

And it is stated that

This last question is intended to open the way for the freest possible suggestion, so that no one can say hereafter that the engineers were asked only to act upon the specific question submitted to them, but were not asked to propose of their own motion such a solution of the problem as might seem to them to be wise.

It is obvious, therefore, that this question is intended to secure from the board of experts a thorough examination of the problem of rapid transit in the city of New York, and to elicit from them suggestions as to the best methods by which rapid transit may be secured, without reference to any other interests than those of the public, in the solution of the problem.

The discussion of this question has been so complete during the past few years that public opinion at length crystallized itself and gave expression to its conclusion in the rapid transit legislation under which the commission has been organized and now exists.

Briefly stated, the law which has been approved by the vote of the people of the city of New York provides:

First. That the first duty of the commission is to adopt plans which will secure rapid transit, by which

is plainly intended transit in the limits of New York, at as high a rate of speed as now ordinarily exists upon the railroads of the country outside of the city limits. If slower transit shall be provided, it must be only as incidental to the main requirements of rapid transit of at least 25 miles per hour, including stops, and a higher rate of speed, if practicable.

It is further provided that the plans adopted, whatever they may be, shall not involve an expenditure on the part of the city of New York of more than $50,000,000.

This expenditure, however, is only to be made upon the condition precedent that a responsible lessee shall be found who will not only deposit $1,000,000 in cash as a contingent security for the completion of the work, but will also give satisfactory bonds to the commission to secure the payment of interest upon the city bonds issued in payment for the construction of the work, and the payment of not less than 1% in addition thereto, into the sinking fund of the city for the ultimate redemption of the bonds so issued.

It may be further stated that the act imposes no obligation upon the commission to expend $50,000,000, and from the whole spirit and tenor it is evident that the commission is expected to secure rapid transit with as small an expenditure on the part of the city as possible.

Bearing these conditions precedent in mind, the board of experts has come to the conclusion that it will be advisable and necessary to modify the plans which have already received the provisional approval of the commission. These plans contemplate a three-track line on the same level from the South Ferry to Vesey St. with a two-track loop at City Hall Park; from the City Hall Park to 14th St. the plans provide for a four-track line; from 14th St. through Broadway and the Boulevard a four-track line, to be constructed partly in subway and partly by viaduct along the Boulevard and 11th Ave. to 185th St.; thence a two-track elevated line is provided at Kingsbridge, and from Kingsbridge a two-track railway, partly in tunnel and partly on embankments.

If this route be adhered to, the board of experts is of the opinion that it should be modified by constructing two tracks in tunnel, instead of three tracks from the South Ferry to the City Hall Park, including the loop, and thence along Broadway with four tracks in tunnel to 92d St. The express and local tracks being placed on different levels, at least as far as 34th St., the construction of two of these tracks may be deferred, if deemed desirable to reduce cost. At 92d St., the tracks will emerge and be continued on an elevated structure to the Morningside Plateau, and thence, partly by a depressed road, partly by tunnel, and partly by viaduct, to 185th St.

This proposed modification will relieve the difficulties of the construction due to four tracks on a level in Broadway below 34th St., and will not require any invasion of the vaults on either side of the street or the underpinning of the buildings on this line. If it should be objected that the deferring of the construction of two of the four tracks will seriously curtail the facilities for local distribution due to frequent stops, the board is convinced that by the use of electric motors an average speed of 25 miles per hour, including stops, with stations one-half mile apart, can be attained throughout the entire line. This would remove this objection and secure rapid transit within the meaning of the law, and a saving of about $3,000,000 above 42d St. would be made.

In confirmation of this view, it may be stated that the stations at 125th, 135th, 145th and 155th Sts. on the 8th Ave. Manhattan line are half a mile apart. The grade descends 10 to 12 ft. per mile toward the north. Express trains of five cars, weighing 115 tons loaded, make speed, including stops, at the rate of 30 miles per hour. Going south against the grade they run at the rate of 20 miles per hour, including stops.

It must be borne in mind that the cable road on the surface of this entire line affords a ready and convenient mode of distributing traffic on the surface. It would be desirable, but not indispensable, to arrange with the Metropolitan Traction Co. for transfer tickets.

It will be observed that the plan suggested proposes four tracks, mostly elevated, between 92d St. and 185th St. This recommendation is made for two reasons:

1. That, as between underground routes and elevated routes a preference should always be given to the latter—not merely because the construction is cheaper, but because the difficulties of adequate light and ventilation are entirely obviated.

2. It has not been suggested to construct less than four tracks between 92d St. and 185th St., because the local distribution will require more frequent stations in order to accommodate the traffic which will be created by the construction of the system through a region offering unexampled attractions for residence.

The heretofore described plan is intended to furnish a rapid transit route upon the west side of the city, the cost of which as estimated by the chief engineer, and as modified as above suggested, will amount to $29,500,000.

For the east side the plan suggested by the chief engineer contemplates an underground line from Union Square, with four tracks, through Fourth Ave. and under the Grand Central Station to 44th St., and thence, with two double-track tunnels, to 97th St., and thence with a four-track steel viaduct to Mott Haven, and thence from Mott Haven to Williamsbridge by a two-track steel viaduct, the estimated cost of which is $22,200,000.

The aggregate cost of the two lines would thus be $51,700,000, to which must be added 10% for the cost of terminals and side tracks, making a total of $56,870,000, showing the necessity for further reduction in cost in order to keep within the limits of the law.

In lieu of the route from 14th St. to City Hall under Broadway, the chief engineer has suggested an alternative route by way of Fourth Ave., Lafayette Place and Elm St. to the City Hall Park, with an extension thence to the South Ferry, either by the Broadway route below the City Hall or by a route through Nassau St., Broad and Water Sts., to the South Ferry, or by both, in which latter case the route might be operated as a loop line.

The board of experts has concluded to recommend the substitution of the Fourth Ave., Lafayette Place and Elm St. line for the Broadway line from 14th St. to City Hall Park. The reasons which have led them to this conclusion are as follows:

1. The cost of the structure will be reduced by the sum of $3,700,000 below the estimated cost of the line on Broadway between 14th St. and the City Hall.

2. The location on Broadway, and consequent crowds at the stations, would increase the congestion of travel which exists in that thoroughfare, and which should not be aggravated.

3. The adoption of this route relieves Broadway from Union Square to the City Hall from the serious interruption of business, which the construction of the tunnel routes through that thoroughfare would involve. In the opinion of the experts, the only justification for such an interference with the traffic on Broadway would rest upon the conclusion that no other suitable route can be found. As a matter of fact, however, the route proposed is no longer and is less expensive than that in Broadway, and being but 450 ft. distant therefrom, affords as much accommodation for rapid transit as could possibly be secured by the Broadway route.

In connection with the Elm St. route, it may be well to state that if the difficulties with the sewerage system at Canal St. should be so great as to make the change desirable, it is perfectly feasible to emerge from the subway at a point between Lafayette Place and Grand St., and continue thence by an elevated structure to a point just north of Leonard St., where the track could re-enter the subway leading to the City Hall Park. This, however, will involve the closing of at least one street at each end of the elevated structure, but inasmuch as the cost of construction will be greatly reduced, the saving would probably cover the land damages which would accrue from the closing or diversion of these streets.

The board of experts recommends that above 14th St. the two express tracks be carried along Broadway in a tunnel in the rock, so as to avoid disturbing the surface of the street between 16th and 25th Sts., and that four tracks be constructed along Fourth Ave. to 23d St., and thence two tracks for local service through 23d St. and under Madison Square to 25th St., above which point the regular four-track system, as previously described, would be resumed on Broadway.

For the east side line the board recommends the construction, from 23d St., of four tracks under Fourth Ave. to 42d St., and thence under the Grand Central Station with two tracks to 97th St., and thence by a two-track elevated structure to Mott Haven, a point where the existing lines of travel may be easily made to converge.

In addition to this route, the board of experts recommends that two tracks shall be constructed in tunnel under 42d St., or one of the adjacent streets, to a connection with the west side route heretofore recommended on Broadway, thus affording an independent, as well as a connecting rapid transit route for through trains between the west and east side lines. In time this tunnel may be extended west, so as to connect with the tracks of the New York Central Railroad now existing along the river front.

The cost of the line thus recommended above 23d St., on the east side, including the 42d St. line as far west as Broadway, will be $12,025,166, thus effecting a saving of about $10,000,000 on the estimated cost of the east side line as proposed by the chief engineer.

The total cost of the lines herein recommended, including an allowance of 10% for terminals and side tracks, will amount to $42,063,721, in lieu of the sum of $56,870,000, cost above estimated.

We suggest also a two-track elevated extension from the Fourth Ave. line westward on one of the streets just north of Central Park to a point near Sixth Ave., and thence northwardly through the blocks to the Harlem River. The length of this line would be approximately two miles, and its cost, assuming the amount paid for right of way through the blocks to be $25,000 per lot, will be approximately $2,500,000. This will serve a district capable of dense population, which is now entirely without means of rapid transit. In the table hereto annexed the cost of this line is not included, as it does not form an essential part of the system.

The board of experts calls attention to the fact that it is perfectly feasible and will ultimately be desirable to extend the west side line from 185th St. by a two-track elevated structure to Kingsbridge, where connection may be made with the main line of the New York Central R. R. The cost of this extension is estimated at $1,500,000.

In like manner it is proper to note that the east side line can be extended from Mott Haven to any desirable points in the annexed region whenever the means required to defray the cost of construction shall be provided by law.

It is suggested that it would be desirable to secure the extension of the New York Central R. R. tracks along the North River front below 59th St., by an elevated structure, so as to be made available for the movement of freight as well as passengers along the wharf front, thus relieving the crowded traffic of the streets, which is now the cause of unnecessary expense and of such vexatious delays as to drive business out of the city and compel its transaction in other places where the facilities for trans-shipment are adequate for the service. For the creation of this exterior line it will not be necessary to resort to the funds of the city, which should be used exclusively, so far as may be necessary, to secure the rapid transit facilities required for the movement of passengers.

Having thus, after an exhaustive examination of the plans, and after a process of careful differentiation, recommended a rapid transit system independent of all existing routes, which can be executed within the limit of cost prescribed by the act, the board of experts feels that it would not obey the mandates of the commission without pointing out the fact that no immediate relief for the existing congestion of travel will be provided by the recommendations hereinbefore submitted. The process of construction will necessarily be slow at the best, and many unforeseen impediments, legal and accidental, may be expected to interfere with the early completion of an undertaking of such great magnitude and difficulty. Moreover, unless a responsible bidder shall be found for the franchise and contract, the undertaking must, by the terms of the act, necessarily be abandoned. Construction by the city itself is not contemplated by the act.

Hence, the board of experts have been led to consider whether an early increase in the facilities for rapid transit can be secured by other agencies pending the construction and completion of the proposed new system of transit.

The board then takes up the question of increasing the facilities of existing lines. It says that rapid transit on the existing surface lines is out of the question, but that the lines of the Manhattan Elevated system might be so altered as to give a great improvement on existing service, and that the commission has authority to compel such alterations. The Manhattan Company's charter obliges it to furnish rapid transit, but at present its local trains make only 12 miles an hour, including stops. Rapid transit, in the view of the commission, means a speed of, at least, 25 miles per hour, including stops. As the quickest means of providing real rapid transit, the board recommends that the Manhattan Elevated be required to construct a third track on each of its lines for express train service only. The east side and west side lines would then be operated as separate systems. In the morning hours the express trains would run south on Third and Sixth Avenues and north on Second and Ninth Avenues. In the afternoon they would move in the reverse direction. As the Sixth and Ninth Ave. lines unite at 53d St., from that point north two additional tracks, instead of one, would be necessary. The board points out that this change would involve the rebuilding and strengthening of the existing elevated structures at many points.

If these improvements should be made, the board further recommends that electric motors be substituted for the steam locomotives on all the elevated lines. By this improvement, the commission believes, the speed of local trains could be increased to 17 miles per hour, including stops. The report then continues as follows:

Objection may be made to the immediate introduction of real rapid transit upon the Manhattan system, on the ground that the new routes hereinbefore recommended may be less attractive to bidders, and therefore the con-

struction of an independent system may be indefinitely postponed. The board of experts believes, however, that before the new system can be put in operation, the increase in traffic will be fully equal to the ultimate capacity of the Manhattan system and of the new lines combined.

The conclusions at which the board of experts have arrived may therefore be briefly summed up as follows:

1. That the provisional line approved by the rapid transit commission may be regarded as impracticable, because its total cost will exceed the limit of $50,000,000 imposed by the rapid transit act.

2. That the route and plan of construction may be so modified, however, as to bring the cost within the limits of the act, as will appear in the table hereto annexed, and still provide for a rapid transit route independent of any existing system both upon the west side and upon the east side, coming together at Union Square, and running thence by a trunk line through Elm St. to the City Hall Park, and thence by Broadway to the South Ferry upon the line heretofore approved by the commission.

3. That the cost of construction can be largely reduced if an arrangement can be made with the New York Central R. R. Co. for the construction of the east side line above 14th St. But if no such arrangement can be made, it will be perfectly practicable to construct the line as an independent route, without interfering in any way with the tracks now occupied and being constructed by the railroad company.

4. That the present condition and growth of business in this city require that all possible routes which may be made to afford rapid transit movement should be utilized, and with that view, the Manhattan system, the New York Central system, and the New York & New Haven R. R. system should all, as far as possible, be required to enlarge the means of transportation for passengers as well as for freight, so that the congestion which now seriously interferes with the growth of business and the value of property shall be reduced to a minimum.

5. Wherever practicable, the use of viaducts adapted for high-speed trains, instead of subways, is recommended.

6. It is recommended to use a form of construction for subways and viaducts that will allow of the construction at first of two tracks only, where desirable, because trains composed of cars equipped with electric motors can be run at a speed of 17 miles per hour, with station 1,500 ft. apart; or at a speed of 25 miles per hour with stations half a mile apart, and with this kind of motor, trains containing more than five cars can be run at the maximum speed, thus making the traffic capacity of two tracks, with electric traction, very much greater than that of the present elevated roads with steam power.

7. The following described route and number of tracks for present construction are recommended (see accompanying table):

Two-track subway from South Ferry to City Hall Park, under Broadway, with loops at Battery and City Hall Parks.

Four-track subway from City Hall Park, under Elm St. and Lafayette Place, to 14th St.

Two-track subway in rock tunnel under Broadway from 14th St. to 25th St., for express trains, to be built without breaking surface of Broadway.

Four-track subway under Fourth Ave. from 14th St. to 23d St., and two-track subway under 23d St. to Broadway for the local trains, joining the express subway at 25th St.

Four-track subway under Broadway from 25th St. to 92d St., to be constructed on different levels at least as far as 34th St.

Four-track structure, mainly viaduct (with subway under Morningside Plateau), along the Boulevard and 11th Ave. from 92d St. to 185th St.

Four-track subway under Fourth Ave. from 23d St. to the Grand Central Station.

Two-track subway under Fourth Ave. from the Grand Central Station to 97th St.

Two-track viaduct along Fourth Ave. from 97th St., thence crossing the Harlem River to Mott Haven.

The length and cost of viaduct and subways are as follows:

Length of subways	13.91 miles
" " viaducts	4.97 "
Total length	18.88 miles
Cost	$42,063,721

These figures are based upon the estimates of the chief engineer of the rapid transit commission heretofore approved as reliable, and include the construction of the railway and stations, reconstruction of sewers, restoration of the street surface, interest on cost during construction, with an allowance for contingencies, and an allowance of 10% for shops, storage tracks, terminal yards, etc., but no allowance for the expenses of administration and engineering, which by the act are not a charge upon the fund. No account has been taken of the cost of property, property rights, or damages to abutting property, but the difference between the estimate of the cost of the modified lines and the fund contemplated by the act ought to be sufficient to cover such expenditures.

Abram S. Hewitt, O. Chanute, Thomas C. Clarke, Wm. H. Burr, Chas. Sooysmith, Board of Experts.

The report of the Massachusetts Board of Railroad Commissioners for the year ending June 30, 1894, shows that no additions were made to the mileage, but that the total was reduced 1.37 miles by realinement and remeasurement, so that there are now 2,118 miles of railway and 4,210 miles of track, exclusive of sidetrack. There were 15 train accidents, in which 9 passengers, 7 employees and 2 trespassers were killed, and 40 passengers and 26 employees were injured. The total number of persons reported as killed or injured was 1,114 (337 less than in the preceding year), of whom 232 were fatally injured. The total number of persons injured at grade crossings was 65, of whom 7 were killed and 17 injured at crossings protected by gates or flags, while 12 were killed and 29 injured at unprotected crossings. This is rather better than the average for the last 10 years, which was: At protected crossings, 23 killed and 32 injured; at unprotected crossings, 25 killed and 30 injured. The total number of protected grade crossings of railways and highways is 1,085, and of unprotected crossings, 1,088. The greatest progress in automatic coupler equipment has been made by the Boston & Albany R. R., which has already 83.5% of its freight cars equipped with the M. C. B. couplers, as against 65% in 1892. The other roads are comparatively far behind. In the air-brake equipment of freight cars, the Boston & Albany R. R. is again in the lead, having nearly 45% of its freight cars so equipped. The Fitchburg R.R. stands next with about 18%, and the New York & New England R. R. purchased 1,200 new cars equipped in this way, these cars being about 20% of its total equipment. During the year, 334 miles of track were laid or relaid with steel rails, as against 299 miles the year before—making the whole length of track now laid with steel 5,906 miles.

The report of the Manhattan Elevated Railway for the quarter ending Dec. 31, 1894, shows a loss of 9,957,800 passengers as compared with the same quarter of 1893. The net earnings on the stock were 1.69% against 3% in 1893, and the total for 1894 was 6.11%. The total earnings in 1893 were $10,994,049 against $9,559,941 in 1894. To the competition of the new cable roads the greater part of this loss is ascribed.

APPORTIONMENT OF EXPENSE, GRADE-CROSSING REMOVAL, AT BUFFALO, N. Y.

The elimination of grade crossings in the city of Buffalo, N. Y., has been under consideration by the railways and the city authorities for several years, but it is only recently that anything definite has been decided upon as to the apportionment of the expense, owing to the number of interests involved and the enormous expense consequent upon the magnitude of the work, a general review of which was given in our issue of Oct. 29, 1887. We are indebted to Mr. Walter Katte, M. Am. Soc. C. E., Chief Engineer of the New York Central R. R., for the accompanying table, showing the apportionment of expense between the city and the different railway companies for the elimination of the grade crossings on this company's lines, as provided for in a contract dated Nov. 30, 1894.

Route.	Via.	Tracks.	Subway, miles.	Viaduct, miles.	Estimated cost.
South Ferry to City Hall	Broadway.	2	1.00	....	$2,250,000
City Hall to 14th St.	New Elm St.	4	1.85	....	6,200,000
14th St. to 23d St.	Fourth Ave.	2 express.	.50	....	883,500
14th St. to 25th St.	Broadway.	4	.44	....	1,200,320
23d St. to 25th St.	23d St. & Madison Sq.	2	.24	....	465,300
25th St. to 185th St.	B'way & Boulevard.	4	5.59	2.65	15,235,460
East side					$26,214,580
23d St. to 44th St.	Fourth Ave.	4	1.03	....	3,382,698
44th St. to Mott Haven	" "	2	2.67	2.32	7,873,718
					$37,470,996
42d St. branch	42d St.	2	.50	....	768,750
			13.91	4.97	$38,239,746
Add 10% for terminals and side tracks					3,823,975
					$42,063,721

ANNUAL MEETING OF IOWA SOCIETY OF CIVIL ENGINEERS AND SURVEYORS.

The seventh annual meeting was held in the rooms of the Board of Trade, Dubuque, Ia., Jan. 16, 18.5, with the president, William Steyh, in the chair. The reports of the secretary, treasurer and executive committee showed that notwithstanding the hard times the society is in a healthy and flourishing condition. The president's address was a review of the work of the society for the past year, particularly in the matter of the good roads problem, showing the reasons for the failure to secure the desired results both in legislation and in practice. Prof. C. D. Jameson, of the Iowa State University, then gave a description of the methods employed at the university in making tests of cements and also in testing paving brick, employing in the latter case a machine of very simple construction, but which, it is thought, gives results very much nearer like those obtained in actual practice than the usual rattler tests. A paper on "Shore Protection," by C. R. Allen, City Engineer of Ottumwa, described the methods employed in controlling the current and stopping bank erosion of the Des Moines River at that place. Other papers were read on various topics, among which were the following: "Shaft Sinking," by J. T. Beard, Ottumwa; "Education for Engineers," by Prof. Higgins, of Des Moines; "Building Stones of Iowa," by Wilkes Williams, of Postville; "Street Grades," by Wm. Steyh, of Burlington; "The Deep Well at Glenwood," by Seth Dean. The following officers were elected for the current year: President, Prof. L. Higgins, Des Moines; Vice-President, C. R. Allen, Ottumwa; Secretary and Treasurer, Seth Dean, Glenwood; Directors, Eugene Anderson, Dubuque, and Wm. Steyh, Burlington. The place for holding the next annual meeting will be determined later by a letter ballot of the members. An excursion to many places of interest to engineers was arranged by the resident members of Dubuque.

ANNUAL MEETING OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS.

The annual meeting of this society was held in Montreal, Jan. 24 and 25. On the first day there was an excursion to the power house of the Montreal electric railway, the water-works pumping station, and the works of the Dominion Bridge Co., Dominion Wire

Buffalo Grade-Crossing Improvement; New York Central R. R.

Location.	Type of structure.	City or N. Y. C. Ry. to construct for or execute.	Railway companies concerned and proportion of cost to railways and city—Per cent. New York Central.	West Shore.	Lake Shore.	Erie.	W. N. Y. & P.	City of Buffalo.	Approaches to be contracted for by City and cost apportioned as follows: New York Central.	West Shore.	Lake Shore.	Erie.	W. N. Y. & P.	Buffalo Creek.	City.
Terrace and Main Sts.	Open cut.*	Railway.	100.00	.....	.....	.....	.....	.....	2/3	....	....	....	....	..	1/3
Washington St.	Bridge.	"	100.00	.....	.....	.....	.....	.....	2/3	....	....	....	....	..	1/3
Michigan St.	Viaduct.	"	100.00	.....	.....	.....	.....	.....	2/3	....	....	....	....	..	1/3
Chicago St.	"	City.	58.37	16.43	.....	14.87	.....	.....	2-9	2-9	....	2-9	....	..	1/3
Louisiana St.	"	"	20.20	8.56	8.20	42.84	.....	20.20	1-6	1-6	1-6	1-6	....	..	1/3
Hamburgh Canal	Lift bridge.	Railway.	100.00	.....	.....	.....	.....	.....	....	....	....	....	....	..	....
Jefferson St.	Viaduct.	City.	56.16	15.83	.....	.....	28.01	.....	2-9	2-9	....	....	2-9	..	1/3
Seneca St.	"	"	56.16	15.83	.....	.....	28.01	.....	2-9	2-9	....	....	2-9	..	1/3
Hamburgh St.	"	"	16.53	5.44	33.43	12.65	20.02	11.93	2-15	2-15	2-15	2-15	2-15	..	1/3
Swan & Seymour Sts.	Subway.	Railway.	70.49	10.63	.....	.....	18.88	.....	2-9	2-9	....	....	2-9	..	1/3
South Division St.	"	"	60.43	29.89	.....	.....	9.68	.....	2-9	2-9	....	....	2-9	..	1/3
Eagle St.	"	"	66.84	33.16	.....	.....	.....	.....	1/3	1/3	....	....	....	..	1/3
Ensslie St.	"	"	44.05	28.85	.....	.....	27.10	.....	2-9	2-9	....	....	2-9	..	1/3
North Division St.	"	"	42.39	28.92	.....	.....	28.69	.....	2-9	2-9	....	....	2-9	..	1/3
Lord St.	"	"	66.84	33.16	.....	.....	.....	.....	1/3	1/3	....	....	....	..	1/3
Clinton St.	"	"	66.84	33.16	.....	.....	.....	.....	1/3	1/3	....	....	....	..	1/3
Oneida St.	"	"	66.84	33.16	.....	.....	.....	.....	1/3	1/3	....	....	....	..	1/3
Smith St.	"	"	66.84	33.16	.....	.....	.....	.....	1/3	1/3	....	....	....	..	1/3
Fillmore Ave.	"	"	68.15	31.85	.....	.....	.....	.....	1/3	1/3	....	....	....	..	1/3
Howard St.	"	"	45.91	54.09	.....	.....	.....	.....	1/3	1/3	....	....	....	..	1/3
William St.	"	"	100.00	.....	.....	.....	.....	.....	2/3	....	....	....	....	..	1/3
								B. C. R.R.							
Clinton St.	"	City.	.....	31.96	.....	.....	.....	68.04	....	1/3	....	....	....	1/3	1/3

* Beam tunnel and Pearl St. foot-bridge.

WEATHER TABLE FOR DECEMBER, 1894. (Furnished to Engineering News by the Department of Agriculture.)

	Stations.	Temperature. (Deg. Fahr.)				Wind.			Precipitation—rain or melted snow—inches.		
						Velocity in miles per hour.		Direction at time of max. velocity.			
		Average.	Max.	Min.	Range.	Average.	Max.		Total.	Heaviest in 24 hours.	No. of rainy days.
Northern Cities.	Northfield, Vt.	21.8	49	—22	71	8.3	46	SW	3.46	1.32	11
	Portland, Me.	27.0	55	2	53	7.7	36	NE	1.75	.88	8
	New York, N. Y.	36.8	57	7	50	10.8	40	NE	5.23	1.98	10
	Pittsburg, Pa.	36.6	62	—4	66	6.9	26	SW	3.10	.88	15
	Chicago, Ill.	32.4	55	—3	58	19.0	60	SW	1.66	1.01	9
	Omaha, Neb.	33.2	61	—8	69	8.0	26	S	.94	.85	7
	St. Paul, Minn.	27 0	51	—14	65	8.2	30	NW	1.53	1.22	7
	Duluth, Minn.	26.2	53	—17	69	6.5	29	NW	1.87	.92	9
	Bismarck, N. Dak.	22.6	59	—23	82	7.9	38	NW	.06	.02	4
	Average.	29.3	56	—9	65	9.3	37		2.18	1.01	9
Southern Cities.	Washington, D. C.	37.4	60	6	54	6.2	34	NW	4.15	1.58	11
	Louisville, Ky.	39.6	69	3	66	8.4	28	N	5.18	1.59	12
	St. Louis, Mo.	38.8	63	1	62	12.4	36	SE	2.73	.97	11
	Savannah, Ga.	53.6	78	12	66	7.8	32	NW	.65	.46	3
	Kansas City, Mo.	37.0	70	Zero	70	10.1	33	SE	1.16	.47	6
	Jacksonville, Fla.	57.7	80	14	66	6.6	32	S	.81	.34	3
	Chattanooga, Tenn.	44.6	68	5	63	6.7	35	W	6.45	1.76	14
	New Orleans, La.	57 8	81	21	60	8.8	35	N	2.01	.66	10
	Memphis, Tenn.	45.5	73	5	68	7.4	29	NW	3.88	1.31	10
	Palestine, Tex.	53.0	81	8	73	6.3	28	W	1.98	1.25	10
	Average.	46.6	73	8	65	8.1	32		2.90	1.04	9
Western Cities.	Helena, Mont.	24.2	51	—12	63	5.3	36	SW	.63	.38	6
	Port Angeles, Wash.	38.0	49	26	23	5.1	48	NE	1.63	.48	12
	San Francisco, Cal.	49.7	61	40	21	9.0	40	S	9.01	1.64	22
	Salt Lake City, Utah	31.4	56	9	47	5.6	46	S	1.28	.43	9
	Santa Fe, N. Mex.	33.7	55	7	48	5.7	26	NE	1.28	.52	10
	Denver, Colo.	31.7	69	—8	77	6.9	40	SW	.69	.40	6
	Yuma, Ariz.	54.8	73	37	35	5.3	32	NW	.40	.25	6
	Average.	37.6	59	14	45	6.1	38		2.13	0.59	10

Mfg. Co., Dominion Wire Rope Co., and the Montreal Wheel & Pipe Founding Co., lunch being served at the bridge works. In the evening the annual dinner was held at the Windsor Hotel.

At the meeting on Jan. 25, the annual report was read and the financial statement showed an income of $4,243 and expenditures of $3,352. The announcement was made of the award of the Gzowski medal to Mr. H. J. Perley for his paper entitled "A Cubic Yard of Concrete." After same discussion on the subject of "Professional Status," the following resolution was adopted:

That the committee on professional status be continued and shall obtain from the membership its opinion as to the desirability of obtaining close corporation powers, and if the membership support the opinion, then the committee shall forthwith proceed to the work of formulating bills of incorporation from the several legislatures for submission to the council, and that the council be authorized to furnish them any legal advice necessary and that the report be sent to the council when ready.

At the evening session, at McGill University, a diploma conferring honorary membership was presented to the Governor-General, Lord Aberdeen. Prof. H. T. Bovey then read a paper on "The Strength of Douglas Fir, Red Pine, White Pine and Spruce," and practical tests were shown on the Wicksteed testing machine.

The following officers were elected for the ensuing year: President, Thomas Monroe, Coteau Landing; First Vice-President, Herbert Wallis, Montreal; Second Vice-President, Martin Murphy, Halifax; Third Vice-President, W. T. Jennings, Toronto; Treasurer, K. W. Blackwell; Secretary, Prof. McLeod; Librarian, William McNab.

ANNUAL MEETING OF THE ILLINOIS SOCIETY OF ENGINEERS AND SURVEYORS.

The tenth annual convention of the society was held at Monmouth, Ill., Jan. 23, 24 and 25, with about 40 members and visitors in attendance. Owing to the large number of papers and topics provided by the programme, some of the less important were read only by title or in brief abstract. Most of the strictly engineering papers, however, received full attention, care having been taken in arranging the programme to group the papers and discussions on allied topics, so that a member could easily consider the entire group in a single discussion. The advantage of this arrangement was evident in the facility with which the large amount of work laid out for the convention was disposed of.

The convention was opened Wednesday evening with an address of welcome from Mr. J. R. Hanna, Vice-President of the Monmouth Mining & Mfg. Co. The report of the Secretary, Jacob A. Harman, showed a large accession of new members during the year, with the finances of the society in a much improved condition. This session was devoted almost entirely to the reading of papers on land surveying and the discussion of land surveying laws and allied subjects. Perhaps the most important thing brought out in this discussion was the fact that a law requiring the licensing of surveyors is being pushed in the State Legislature by the officers of the State University.

On Thursday the work of reading papers was resumed with a paper on "Purification of Sewage by Intermittent Downward Filtration," by Prof. A. N. Talbot, University of Illinois. This paper was a general summary of recent practice and experiments in purifying both sewage and water by this process of filtration, practically all of which have been described in this journal. The discussion was opened by Mr. D. W. Mead, of Rockford, who urged careful attention to sewage and water purification by the smaller cities and towns, and advised the adoption of underground sources of water supply whenever possible. Next came a brief and very general paper on "Preservation of All Sources of Water Supply from Sewage," by Mr. R. E. Orr, of Evanston, and a concise and well-written paper on "Comparisons in Practice of the Metric and English Systems of Weights and Measures," by Mr. A. Lagron, of Freeport. There was a short discussion of this paper which was followed by a formal discussion of the topic, "Effect of Size and Grade of Sewers, and the Distance Away from the Tank, upon the Efficiency of Automatic Flush Tanks for Flushing Sewers." Much of this discussion was irrelevant to the subject, and very little information of value was brought out. Prof. A. N. Talbot stated that in some crude experiments made by him he found that with an 800-gallon tank and a low-grade, 10-in. sewer there was 3 ins. of water 2,000 ft. from the tank and 2½ ins. of water 4,000 ft. from the tank. The current was a little greater than what the grade would call for, using the ordinary formula. Mr. Dabney H. Maury, Jr., Supt. Water-Works, Peoria, suggested that in many cases the efficiency of flush tanks might be largely added to by arranging for the simultaneous discharge of a number, so that the greater volume of water coming from the laterals would serve to some extent to flush the mains as well as the laterals.

The first business at the afternoon session was the consideration of proposed amendments to the constitution of the society. These amendments provided for a larger executive board and some changes facilitating the election of members, and were all adopted. The paper following was by Prof. Ira O. Baker, University of Illinois, on "Engineering Education at the University of Illinois," which resolved into a vigorous extempore address upon the standing and dignity of engineering as a learned profession and the duty which the engineer owed his profession in insisting upon a recognition of this standing. Prof. Baker's address was followed by a paper on "How Ottawa, Ill., Obtained a System of Water-Works," by Mr. N. E. Stucker, City Engineer. We shall give some of the details of the pipelaying of this system in a future issue. Mr. C. C. Stowell, City Engineer, Rockford, then read a very complete historical paper upon the "Rockford Water-Works System." The covered reservoir built for this system was described and illustrated in our issue of Feb. 22, 1894. These papers were followed by a general discussion of the "Cost of Pumping Water from Wells to Reservoir," in which the air-lift pump came in for considerable attention. As we expect to give exact figures of the experience with this pump in several of the towns mentioned, the facts brought by the discussion will be postponed until that time. The session closed with the election of the following officers for the ensuing year: President, Daniel W. Mead, Rockford; Vice-President, P. C. Knight, Pontiac; Executive Secretary, Jacob A. Harman, Peoria; Recording Secretary, C. A. Miller; Trustees, S. S. Greeley, Chicago; A. N. Talbot, Champaign; J. H. Burnham, Bloomington.

The evening session was devoted for the most part to a paper on "Brick Pavement Construction," by Mr. A. D. Thompson, of Peoria, Ill., and the discussion of the several topics relating to this subject. The paper, which was quite long, recommended the use of small-size bricks in preference to blocks, and urged the necessity of complete tests of all materials, especially the brick and cement, when a concrete foundation was used. The tests for the brick should comprise a test for absorption, for transverse strength and for abrasion, while the tests for cement should be for fineness, setting, tensile strength and checking. For filling between the joints, sand was considered preferable to grout or the various forms of mastic. Especial stress was laid upon the necessity for complete and detailed specifications.

The discussion of this paper was opened by Prof. I. O. Baker, who took up the questions of size of bricks and the character of the joint-filling especially. He considered that the large size bricks, say 4 × 5 × 12 ins., had two advantages: (1) they could be laid faster, or rather the pavement could be laid faster when using large bricks, and (2) they gave fewer joints. On the othe hand, large bricks had the disadvantages of (1) being more costly to burn, and (2) the rejected brick could not be used for building. As for the joint filling, this was made (1) to strengthen the pavement, by giving the brick lateral support, and (2) to render the pavement impervious to water. Sand was the best filling. Grout was objectionable, because, unless exceeding care was taken, it only filled the upper portion of the joint. There was something of the same objection with pitch and other mastics. Regarding foundations, he considered concrete the ideal foundation, where the circumstances and traffic would warrant it, but he believed that in many places a gravel or broken-stone foundation, with a sand cushion, served all purposes.

Mr. Jacob A. Harman stated that concrete had been adopted in Peoria because he considered it the most durable form of foundation. In respect to the sand cushion, he had been using a 2-in. layer, but observation had made him think that this was too much, and the specifications for the present year called for 1 in. of sand on top of the concrete. A 4 × 5 × 12-in. brick was too large. The 2½ × 4 × 8-in. bricks now used in Peoria were about the right size, and were easily manufactured, and besides enabled the seconds to be sold for building purposes. The absorption which a good brick would stand, depended upon the chemical composition of the clay from which the brick was made. Bricks made from some clays would have an absorption of 3%, and be good for paving purposes, while from other clays an absorption of 1¾% was too great. One of the greatest faults of paving brick, as now made, was the presence of laminations. Manufacturers seemed to have made little progress in correcting this fault.

Mr. W. S. Purington, of the Purington Paving Brick Co., Galesburg, Ill., stated that from a manufacturer's point of view the one thing needed was a uniform specification regarding size of paving brick. Hardly any two specifications were alike in this respect. He believed that within a few years engineers would come to the belief that an absorption of 3% was perfectly allowable. The abrasion tests now made were of little value, from the fact that they were seldom uniformly conducted. It was seldom that one abrasion test could be compared with another.

Mr. D. W. Mead contradicted the statement that pavment could be laid faster with large than with small bricks. Large bricks were more difficult to handle, and tired the men sooner. Concrete was undoubtedly the ideal foundation, but, at the same time, a cheaper foundation was all that some cities could afford, and in many cases was all that was necessary. He regarded a 2-in. cushion of sand as better than any less thickness.

The Friday morning session was devoted to reading several of the papers left over from the preceding sessions, and the completion of unfinished business. In the afternoon a visit was made to the sewer-pipe manufactory of the Monmouth Mining & Mfg. Co., located some distance out of town. This is claimed to be one of the most complete plants in the West for the manufacture of sewer pipe. The material used is a mixture of surface clay and underground clay, mixed in about equal parts, and is claimed to give an unusually strong pipe. All material is obtained on the company's own property, in the near vicinity of the mills, the river clay being taken from a depth of about 90 ft. Nearly 45 acres of ground is covered by this mining work. From the mines the material passes through the mixers, pressure cylinders, dies, and drying rooms, in the usual manner. Perhaps the most noticeable feature of this process is the extent to which conveying machinery is used for handling the material. The kilns are 12 in number, and each is placed under an independent building. Coal is used for firing the kilns. In connection with the sewer-pipe factory, this same firm operates a large stoneware pottery. The officers of the company are: Wm. Hanna, President; J. R. Hanna, Vice-President, and C. C. Merridith, Secretary and Treasurer.

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PERSONALS.

Mr. Maurice Hillman, formerly City Surveyor of Atlantic City, N. J., died in that place Jan. 27.

Mr. Henry Epping, of the firm of Epping, Carpenter & Co., Pittsburg, Pa., manufacturers of steam pumps, died on Jan. 22.

Mr. Clement Gould, President of the Gas Engine & Power Co., of New York city, died Jan. 17. He was born in Massachusetts in 1842.

Mr. Joseph A. Eno, of Newark, N. J., inventor of the Eno rail joint and other devices, died Jan. 23. He was born at Plainfield, N. J., in 1836.

Mr. Foree Bain has removed his offices to 1657 The Monadnock, Chicago, where he will continue a general practice as electrical and mechanical engineer.

Mr. Samuel B. Jones, of Fredonia, N. Y., who died recently, was at one time Superintendent of the Memphis Division of the Louisville & Nashville R. R.

Mr. C. A. Schenck has been appointed Manager of the National Water Tube Boiler Works, of New Brunswick, N. J., succeeding the late Mr. W. E. Kelly.

Mr. George Evener, of Coal Valley, Ill., who died Jan. 21, at the age of 83, was formerly a railway contractor and built part of the Rock Island & Peoria R. R.

Mr. Thomas Slater, an engineer formerly in the employ of the Department of Public Works, New York city, died at Port Richmond, Staten Island, N. Y., Jan. 29,

Mr. L. C. Heywood, Town Engineer of Lincoln, R. I., for the past 18 months, died on Dec. 12. Mr. Wm. F. Keene was appointed on Jan. 18 to fill the vacancy thus caused.

Mr. Olaf R. Olsen, proprietor of the Indianapolis Machine & Bolt Works, Indianapolis, Ind., died Jan. 25. He was born in Denmark in 1849 and came to this country in 1873.

Capt. Carl F. Palfrey, U. S. Engineers, will be relieved from duty under the orders of Col. O. M. Poe, and will proceed to Milwaukee, Wis., and relieve Major James F. Gregory.

Mr. Darius N. Payson has been appointed Deputy Superintendent of Streets at Boston, Mass., vice Mr. Charles R. Cutter. Mr. Payson is a member of the firm of Payson & Co., paving contractors.

Mr. Wesley Wentworth, Manager of the Haverhill, Merrimac & Amesbury Electric Ry., has resigned to accept the position of Assistant Manager of the Lowell & Suburban Ry., at Lowell, Mass.

Mr. Thomas Dolan, who has been elected the first President of the new National Association of Manufacturers, is Vice-President of the Cramp Ship & Engine Building Co., of Philadelphia, Pa.

Mr. Samuel W. Armistead, Naval Constructor, U. S. N., died at Mare Island Navy Yard, Cal, Jan. 28. He was struck by a parting hawser at the delivery of the "Olympia" to the Government, and received injuries which proved fatal.

Prof. E. J. De Smedt, of New York city, died Jan. 25, at the age of 74. He was well known in connection with his patents on asphalt paving and was for some years chemist and inspector of asphalt and cement for the District of Columbia.

Mr. B. Thomas, President and General Manager of the Chicago & Western Indiana R. R., and Belt R. R. of Chicago, has been elected Chairman of the General Managers Association of Chicago, vice Mr. E. St. John, resigned.

Mr. William O. Webber, M. Am. Soc. M. E., of Boston, Mass., has severed his connection with the Henry R. Worthington Co., and opened an office in the Mason Building as consulting engineer, paying special attention to the economy of steam power plants.

Mr. H. M. Perry, Foreman of the Car Department of the Cincinnati Southern Ry. shops at Ludlow, Ky., has accepted the position of Manager of the Madison Car Works, at Madison, Ill. He was formerly Superintendent of the United States Rolling Stock Co.

Mr. Franklin Darracott, civil engineer and for the last 15 years President of the Nason Manufacturing Co. of New York, died on Jan. 24. Mr. Darracott was born in Boston, in 1821, and as engineer surveyed the line for the Boston & Albany Ry. and otherwise practiced this profession for some years.

Mr. C. D. Slocum, Assistant Engineer of the Safety Car Heating & Lighting Co., of New York city, was killed on the Pennsylvania R. R. at Marion, N. J., on Jan. 23. Mr. Slocum had been with the Safety Car Heating & Lighting Co. for four years, and had for some time been in charge of the company's electrical department.

Mr. H. D. Bush, M. Am. Soc. C. E., of Portland, Ore., has finished the construction of the Bull Run pipe line for that city (on which work he was engineer and superintendent for the contractors), and has undertaken the erection of the large steel gates for the government locks at the Cascades of the Columbia River. These gates are furnished by the Maryland Steel Co., to the general contractors, J. G. & J. N. Day.

Sir Edward Leader Williams, M. Inst. C. E., Chief Engineer of the Manchester Ship Canal, has resigned from active connection with the works, but will retain the title of Chief Engineer, and will continue to advise the company on all matters relating to engineering, and, in particular, will take charge of all arbitrations and disputes in which engineering questions are involved. Mr. W. H. Hunter, Principal Assistant Engineer for many years, will have control of the executive work.

Lieut. Robert B. Dashiell, U. S. N., will, it is said, leave the service in April, and enter the employ of the Cramp Ship & Engine Building Co., Philadelphia, Pa. He graduated from the Naval Academy in 1883, and has been in charge of the Indian Head proving grounds for some time, but was detached from this duty in August, 1893, to join the "New York." During his ordnance duty he invented many devices of value to the service, notably a breech mechanism for rapid fire guns, which has been adopted by the service.

Mr. A. T. Hay, who died at Burlington, Ia., Jan. 22, at the age of 69, was the inventor of what is known as the Hay steel, which was used in the construction of the first steel bridge over the Missouri River, at Glasgow, Mo. A span of 314 ft. fell when nearly completed, owing to the falseworks being carried away by ice, and the steel developed excellent quality in the test of this fall, as recorded in the Trans. Am. Inst. Min. Engrs., 1879, Vol. VII., p. 393. The steel was manufactured by the Edgar Thomson Steel Co. by the Bessemer process, and rolled to shapes by Hussey, Howe & Co. and Andrew Kloman.

Mr. Henry Brevoort Renwick, engineer and expert in patent cases, died in New York on Jan. 27, aged 78 years. Mr. Renwick was the eldest son of the late Prof. James Renwick, of Columbia College, and a brother of James R. Renwick, the architect, and Edward B. Renwick, also a well-known authority on patents. Mr. H. B. Renwick was for a long time an examiner in the U. S. Patent Office; was the first U. S. inspector of steamers at the port of New York, and was engaged in a number of the national engineering works in this neighborhood, including the construction of the breakwaters at Sandy Hook and Egg Harbor. He was also connected with the government survey to fix the boundary lines between Maine and New Brunswick.

Mr. Rudolph Eickemeyer, of Yonkers, N. Y., inventor of the Eickemeyer electric motor, died at Washington, D. C., Jan. 23. He was born in Bavaria, and in 1850 came to this country. In 1854 he went to Yonkers and established a machine shop. He invented several machines used in the manufacture of hats. For several years he gave special attention to electrical work and invented dynamos and motors and a form of armature winding which have been extensively used, the motors having been applied to passenger elevators and car-lighting plants. Mr. Eickemeyer and Mr. Stephen D. Field invented an electric railway system which was purchased by the General Electric Co. He also designed alternating current apparatus. He was one of the Committee of Fifteen appointed by the Common Council Sept. 9, 1872, to consider the introduction of water into Yonkers. The Board of Water Commissioners was organized in 1873, and Mr. Eickemeyer was one of the first Commissioners. On May 6, 1881, he was elected President of the Board, which office he had since held.

Mr. J. Wolfe Barry, C. B., M. Inst. C. E., the engineer of the Tower Bridge, in London, lately made a claim upon the Bridge House Estates for some additional remuneration in connection with his services as engineer. Extra work required upon the bridge considerably increased the original estimated cost of the structure, and hence lengthened the time of completion. This threw upon Mr. Barry much additional expense for assistant engineers, superintendents, clerks of the works, and others. He considered that, for extra services and money out of pocket, he was strictly entitled to $83,250 in addition to the stipulated sum. After some friendly discussion he was awarded $60,000 in full of all claims, and he has consented to act as consulting engineer of the bridge for three years without pay.

Col. Horace Scott, of Louisville, Ky., died Jan. 24. He was born in Halifax, Vt., in 1826, and began his railway service as a switchman on the Connecticut Valley R. R. In 1864 he was Superintendent of the Fairhaven R. R., with office at New Bedford, Mass., and in 1865 he accepted the position of General Superintendent of the Jeffersonville, Madison & Indianapolis R. R. In 1874 he was elected President of the Union R. R. Co., at Indianapolis, which controlled the entrance to the Union station in that city. He was also Vice-President of the Belt R. R.; President of the Louisville Bridge Co., and Vice-President of the Union Stockyards Co., of Indianapolis. After the Pennsylvania Co. had bought the J., M. & I. road, Col. Scott continued as General Superintendent for a couple of years, but resigned in 1879. Then he built the Columbus, Hope & Greensburg R. R., now part of the Cleveland, Cincinnati, Chicago & St. Louis Ry., and threatened to parallel the J., M. & I. R. R. between Jeffersonville and Columbus, Ind., but later he ceased his opposition. In 1882 he formed a partnership with John Lyle, editor of the Columbus (Ind.) "Democrat," and they built a railway in Florida, and also a branch of the Louisville & St. Louis Air Line to Cannelton, Ind. Other railway enterprises were engaged in by them, but they did not prove successful. Col. Scott was at one time a very rich man, but it is understood he died poor.

ENGINEERING SOCIETIES.

COMING TECHNICAL MEETINGS.

ENGINEERS' CLUB OF PHILADELPHIA.
Feb. 2. Secy., L. F. Rondinella, 1122 Girard St.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Feb. 4. Secy., C. L. Annan, City Engineer's Office.
ENGINEERING SOCIETY OF WESTERN NEW YORK.
Feb. 4. Secy., Geo. R. Sikes, Buffalo, N. Y.
WESTERN SOCIETY OF ENGINEERS.
Feb. 6. "Description of the Work on the Brighton and Summit Divisions of the Drainage Canal," A. E. Kastl and E. R. Shnable. Secy., Chas. J. Roney, 1736 Monadnock Block, Chicago.
ENGINEERS' CLUB OF ST. LOUIS.
Feb. 6. Secy., W. H. Bryan, Turner Block.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Feb. 6. Secy., Francis Collingwood, 127 E. 23d St., New York.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
Feb. 7. Secy., C. H. McLeod, 112 Mansfield St., Montreal.
FRANKLIN INSTITUTE, PHILADELPHIA.
Feb. 8. "Sulphur-Containing Petroleums of Ohio and Canada," by C. F. Mabery. Secy., W. H. Wahl, 16 South Seventh St., Philadelphia.
ENGINEERS' CLUB OF INDIANAPOLIS.
Feb. 9. Secy., C. C. Brown, City Engineer.
MONTANA SOCIETY OF CIVIL ENGINEERS.
Feb.9 Secy., G. O. Foss, Helena, Mont.
WISCONSIN POLYTECHNIC SOCIETY.
Feb. 11. Secy., Geo. G. Mason, 144 8th St., Milwaukee.
ENGINEERS' CLUB OF KANSAS CITY.
Feb. 11. Secy., F. W. Tuttle, Baird Building.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
Feb. 12. Secy., F. C. Osborn, 721 Hickox Building.
NORTHWESTERN SOCIETY OF ENGINEERS.
Feb. 12. Secy., D. W. McMorris, Burke Building, Seattle, Wash.
NORTHWESTERN RAILWAY CLUB.
Feb. 12. Secy., W. D. Crosman, Ryan Hotel, St. Paul.
DENVER SOCIETY OF CIVIL ENGINEERS.
Feb. 12. Secy., F. Ed. King, 36 Jacobson Block.
NEW ENGLAND RAILROAD CLUB.
Feb. 13. Secy., P. M. Curtis, P. O. Box 1576, Boston, Mass.
ENGINEERS & ARCHITECTS' CLUB OF LOUISVILLE.
Feb. 14. Secy., Jas. K. Zollinger, Norton Building.
ENGINEERING ASSOCIATION OF THE SOUTH.
Feb. 14. Secy., H. D. Ruhm, Nashville, Tenn.
ENGINEERS' CLUB OF MINNEAPOLIS.
Feb. 18. Secy., E. Nexsen, Kasota Block.
COLUMBIAN ENGINEERING SOCIETY.
Feb. 19. Secy., W. F. Hart, Washington, D. C.
WESTERN RAILWAY CLUB.
Feb. 19. Secy., W. D. Crosman, Club Room 9, Grand Pacific Hotel, Chicago.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
Feb. 20. Secy., J. H. Pilcher, Roanoke, Va.
ENGINEERS' AND ARCHITECTS' ASSOCIATION OF SOUTHERN CALIFORNIA.
Feb. 20. Secy., F. Van Vleck, Los Angeles, Cal.
NEW YORK RAILROAD CLUB.
Feb. 21. Secy., John A. Hill, 256 Broadway, N. Y. City.
BOSTON SOCIETY OF CIVIL ENGINEERS.
Feb. 20. Secy., S. E. Tinkham, City Hall, Rooms, 36 Bromfield St.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
Feb. 21. Secy., D. Carhart, Carnegie Library Building, Allegheny.
ENGINEERS' CLUB OF CINCINNATI.
Feb. 21. Secy., J. F. Wilson, 24 W. 4th St.
AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
Feb. 27. Secy., F. R. Hutton, 12 W. 31st St., New York.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
March 1. Secy., O. H. Von Geldern, 719 Market St., San Francisco.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
March 15. Secy., D. W. Meeker, St. Paul, Minn.
CENTRAL RAILWAY CLUB.
March 27. Secy., S. W. Spear, East Buffalo Iron Works, Buffalo, N. Y.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
April 18. Atlanta, Ga., Secy., F. A. Charpiot, Macon, Ga.

CIVIL ENGINEERS' CLUB OF ROCHESTER.—This is a new club organized at Rochester, N. Y., as a branch of the Rochester Academy of Science. The club has at present 25 members. The officers are: President, Emil Kuichling; Secretary, J. Y. McClintock, City Engineer of Rochester.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.—The name of Mr. W. G. Wilkins, First Vice-President, was omitted from the list of new officers, in our issue of Jan. 24, Mr. Emil Swensson being Second Vice-President.

ENGINEERS' CLUB OF PHILADELPHIA.—At the meeting of Jan. 19 officers were elected for the present year as follows: President, George S. Webster; Vice-President, John L. Gill, Jr.; Secretary, L. F. Rondinella; Treasurer, George T. Gwilliam; Directors, W. C. Furber, Henry Leffman and Edgar Marburg. The retiring President, John C. Trautwine, Jr., addressed the club upon "Engineering Progress in Philadelphia during 1894." The Finance Committee reported that after paying all outstanding debts and placing 20% in the sinking fund the club would be enabled to extinguish the loan secured by two-year notes and still have a balance of $800 in its treasury.

L. F. Rondinella, Secy.

WESTERN RAILWAY CLUB.—The monthly meeting of the Club was held at the Auditorium Hotel, Chicago, Jan. 15. Most of the session was devoted to the reading of the paper on "Economy in the Use of Coal by Railways," by Mr. S. P. Bush, Superintendent of Motive Power, Pittsburg, Cincinnati, Chicago & St. Louis Ry., and the discussion of this paper and the paper on the "Heat Value of Western Coals," read at the December meeting of the club by Mr. Wm. Forsyth, Mechanical Engineer, Chicago, Burlington & Quincy R. R. Mr. Forsyth's paper was published practically in full in our issue of Jan. 17, and an abstract of Mr. Bushe's paper and the following discussion will be given in our next issue. At the conclusion of the discussion on the papers of Mr. Bush and Mr. Forsyth a paper entitled "Notes on English Railway Practice" was read by Mr. F. A. Delano, Superintendent of Freight Terminals, Chicago, Burlington & Quincy R. R. At the meeting to be held on Feb. 19 Mr. Geo. Gibbs, Mechanical Engineer, Chicago, Milwaukee & St. Paul Ry., will read a paper entitled "Notes on Modern Practice in Signaling."

CONSTRUCTION NEWS.

CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

Bids to be opened.	Work.	Place.	See Eng. News.
Feb. 1.	Electric lighting,	Corry, Pa.	Dec. 13
Feb. 1.	Water supply.	Corry, Pa.	Dec. 13
Feb. 1.	Gas plant,	Peoria, Ill.	Dec. 27
	Advertised, Eng. News, Dec. 27.		
Feb. 1.	Electric light plant,	Peoria, Ill.	Dec. 27
	Advertised, Eng. News, Dec. 27.		
Feb. 1.	Steel swing bridge,	Port Huron, Mich.	Jan. 3
Feb. 1.	Pipe, valves, etc.,	Cleveland, O.	Jan. 10
Feb. 1.	Water bonds ($25,000),	Ludlow, Vt.	Jan. 24
Feb. 1.	Grading,	Brooklyn, N. Y.	Jan. 24
Feb. 1.	High school building,	Luverne, Minn.	Jan. 24
Feb. 1.	Sewers,	Cincinnati, O.	Jan. 24
Feb. 1.	Viaduct approach	Milwaukee, Wis.	Jan. 24
Feb. 2.	Stone crusher,	Summit, N. J.	Jan. 24
	Advertised Eng. News, Jan. 24 and 31.		
Feb. 2.	Artesian well,	De Smet, S. Dak.	Jan. 31
Feb. 4.	Bridge,	Natchez, Miss.	Dec. 13
Feb. 4.	Paving bonds ($31,400),	Covington, Ky.	Jan. 3
Feb. 4.	Electric plant,	Crowley, La.	Jan. 10
Feb. 4.	Water bonds,	Dunlap, Ia.	Jan. 17
Feb. 4.	Sewers,	Washington, D. C.	Jan. 17
	Advertised, Eng. News, Jan. 17 and 24.		
Feb. 4.	Dredging,	Philadelphia, Pa.	Jan. 17
Feb. 4.	Water-wks. system,	Crowley, La.	Jan. 17
Feb. 4.	Pipe sewers,	Atlanta, Ga.	Jan. 24
Feb. 4.	Stone,	Cincinnati, O.	Jan. 24
Feb. 4.	Brick paving,	Toledo, O.	Jan. 24
Feb. 4.	Water bonds,	Rochester, Mich.	Jan. 24
Feb. 4.	Brick sewers,	Atlanta, Ga.	Jan. 24
Feb. 4.	Plans for school bldg.,	Eau Claire, Wis.	Jan. 24
Feb. 4.	Artesian wells,	Toledo, O.	Jan. 31
Feb. 5.	Water-wks. system,	Fort Plain, N. Y.	Jan. 17
	Advertised, Eng. News, Jan. 17 and 24.		
Feb. 5.	Sewer, St. Louis,	Mo.	Jan. 17
Feb. 5.	Water-wks. system,	Beaver Falls, Pa.	Jan. 17
	Advertised, Eng. News, Jan. 17 and 24.		
Feb. 5.	P'mps, filter plant, etc.,	Beaver Falls	Jan. 17
	Advertised, Eng. News, Jan. 17 and 24.		
Feb. 5.	Pipe sewers,	Mount Vernon, Ind.	Jan. 24
Feb. 5.	Bridge,	Frankfort, Ind.	Jan. 24
Feb. 5.	Water-works system,	Waupun, Wis.	Jan. 24
Feb. 5.	Bridge masonry,	Frankfort, Ind.	Jan. 24
Feb. 5.	Grading,	New York, N. Y.	Jan. 31
Feb. 5.	Paving,	Columbus, O.	Jan. 31
Feb. 5.	Macadamizing, etc.,	Glencoe, Ill.	Jan. 31
Feb. 5.	Sewer,	New York, N. Y.	Jan. 31
Feb. 5.	Garbage collection,	St. Paul, Minn.	Jan. 31
Feb. 5.	Sewer,	Columbus, O.	Jan. 31
Feb. 5.	Street supplies,	New York, N. Y.	Jan. 31
Feb. 6.	Water-wks. system,	Canton, Miss.	Jan. 17
Feb. 6.	Heat'g & vent'l'g app.,	St. Albans, Vt.	Jan. 17
	Advertised, Eng. News, Jan. 17 and 24.		
Feb. 6.	Iron bldg. work, etc.,	Mansfield, O.	Jan. 17
Feb. 6.	Water-works franchise,	Canton, Miss.	Jan. 24
Feb. 6.	Bridge,	Warren, O.	Jan. 24
Feb. 6.	Boiler,	Portland, Ore.	Jan. 24
Feb. 6.	Brick paving,	Indianapolis, Ind.	Jan. 31
Feb. 6.	Air lock and iron shells, tunnel,	Chicago.	Jan. 31
Feb. 7.	Street improvements,	Avondale, O.	Jan. 17
Feb. 7.	Artesian well,	Knoxville, Ill.	Jan. 24
	Advertised. Eng. News, Jan. 24 and 31.		
Feb. 7.	Annex to almshouse,	Jersey City, N. J.	Jan. 31
Feb. 9.	Building plans,	Dallas, Tex.	Jan. 3
Feb. 9.	Water-wks. extensions,	New Orleans.	Jan. 10
	Advertised, Eng. News, Jan. 10 to 31.		
Feb. 9.	Electric light bonds,	Morrisville, Vt.	Jan. 31
Feb. 11.	Jail,	Beaumont, Tex.	Dec. 13
Feb. 11.	Stand-pipe, etc.,	Dunlap, Ia.	Jan. 17
Feb. 11.	Electric wiring,	Dallas, Tex.	Jan. 17
Feb. 11.	Macadamizing, etc.,	Wabash, Ind.	Jan. 31
Feb. 11.	Macadamizing,	Sparta, Wis.	Jan. 31
Feb. 11.	Ferry depot,	San Francisco, Cal.	Jan. 31
Feb. 11.	Grading and filling,	Oshkosh, Wis.	Jan. 31
Feb. 11.	Electric light bonds,	Oxford, Mich.	Jan. 31
Feb. 11.	Water bonds,	Oxford, Mich.	Jan. 31
Feb. 11.	Plans for city hall,	Antigo, Wis.	Jan. 31
Feb. 11.	Dredging,	Boston, Mass.	Jan. 31
	Advertised, Eng. News, Jan. 31		
Feb. 12.	Water-works system,	Forest City, Ia.	Jan. 24
Feb. 12.	Bridge,	Butte, Mont.	Jan. 31
Feb. 12.	River improvement,	Columbus, O.	Jan. 31
Feb. 13.	Dredging, etc.,	Cleveland, O.	Jan. 24
Feb. 13.	Enlarging asylum,	Waterbury, Vt.	Jan. 24
Feb. 14.	Pub. bldg. work at	New Berne, N. C.	Jan. 17
	Advertised, Eng. News, Jan. 17 and 24.		
Feb. 15.	Stone dam,	Holyoke, Mass.	Dec. 13
	Advertised, Eng. News, Dec. 13 to Jan. 24.		
Feb. 15.	Market house,	Cincinnati, O.	Jan. 24
Feb. 15.	Pump and boilers,	Willimantic, Conn.	Jan. 31
	Advertised, Eng. News, Jan. 31 and Feb. 7.		
Feb. 15.	Electric wiring,	Lafayette, Ind.	Jan. 31
Feb. 16.	Sewers,	Cincinnati, O.	Jan. 24
Feb. 18.	Removing boulders,	Portland, Me.	Jan. 24
	Advertised, Eng. News, Jan. 24 to Feb. 14.		
Feb. 18.	Stone,	Portland, Me.	Jan. 24
	Advertised, Eng. News, Jan. 24 to Feb. 14.		
Feb. 18.	Dredging,	Norfolk, Va.	Jan. 24
Feb. 18.	Removal of ledge,	Portland, Me.	Jan. 24
	Advertised, Eng. News, Jan. 24 to Feb. 14.		
Feb. 19.	Torpedo boats,	Washington, D. C.	Dec. 6
Feb. 19.	Hydraulic elevators,	Washington, D. C.	Jan. 24
Feb. 19.	Plumbing at	New York, N. Y.	Jan. 31
	Advertised, Eng. News, Jan. 31 and Feb. 7.		
Feb. 19.	36-in. wooden stave pipe line,	Dallas, Tex.	Jan. 31
	Advertised, Eng. News, Jan. 31 to Feb. 14.		
Feb. 19.	Addition to U. S. print's house,	Wash'n.	Jan. 31
Feb. 19.	Pumping engine,	Oil City, Pa.	Jan. 31
Feb. 20.	Water bonds ($25,000),	Kamloops, B. C.	Jan. 10
Feb. 20.	Metal work,	Portland, Ore.	Jan. 17
	Advertised, Eng. News, Jan. 17.		
Feb. 20.	Asphalt paving,	Ottawa, Ont.	Jan. 17
Feb. 20.	Breaking rock,	New York, N. Y.	Jan. 24
	Advertised, Eng. News, Jan. 24 to Feb. 14.		
Feb. 20.	Snagboat,	St. Louis, Mo.	Jan. 24
	Advertised, Eng. News, Jan. 24 to Feb. 7.		
Feb. 26.	Jail,	Beaumont, Tex.	Jan. 31
Feb. 28.	Breakwater repairs,	Duluth, Minn.	Jan. 24
May 15.	Plans, etc., for bridge,	Montreal	Jan. 24
	Advertised, Eng. News, Jan. 24 and 31.		
No date.	Railway in Arkansas (20 miles).		Jan. 17
	Advertised, Eng. News, Jan 17		
"	" .Engines, dynamos, etc.,	Troy, Ala.	Jan. 31

RAILWAYS.

East of Chicago.

BLUE MOUNTAIN.—Wm. C. Mayne, General Counsel, 926 Walnut St., Philadelphia, sends us the following information: This railway is projected from Harrisburg, Pa., to Slatington, via Linglestown, Shellsville, Jonestown, Fredericksburg, Millersburg and Strausstown, where the road diverges running southeast to Reading, via Bernville; the main line continues on east from Strausstown to Slatington, via Hamburg, New Albany, New Tripoli, opening up a great slate belt. At Slatington connections are made with the Pennsylvania, Poughkeepsie & Boston, via Poughkeepsie Bridge to Boston and New England points. The distance from Harrisburg to Slatington is 75 miles; Harrisburg to Strausstown, about 42 miles; Strausstown to Reading, 18 miles. Definite locations of the road have been made between Harrisburg and Reading and three-fourths of the right of way acquired upon which work, consisting of grading, masonry, culverts, etc., has been done, which by the last measurement amounted to $350,000. Between Strausstown and Slatington a preliminary survey has been made, but no rights of way acquired. The Blue Mountain R. R. Co. is a reorganization of the South Mountain R. R. Co. and permanent organization will be effected as soon as the weather will permit the engineers to make revisions in the location and stake off station plots between Harrisburg and Reading; this will require about three weeks of good weather, which has not been had along the line on account of snow the last six weeks. As soon as the contracts and agreements relative to the rights of way have been adjusted, financial arrangements will be made under a mortgage and that portion of the line between Reading and Harrisburg will be first opened to bids for contracts. Pres., Clinton Rorer, Chestnut Hill, Philadelphia; Ch. Engr., Robert Frazer, 926 Walnut St., Philadelphia.

CONCORD & MONTREAL.—The officials of this company are reported as arranging to relay its road with 100-lb. steel rails.

CHICAGO, INDIANAPOLIS & CHATTANOOGA SOUTHERN.—A resident of Rockport, Ind., writes us as follows: This company intends to build from Rockport, Ind., to Mitchell, Ind., a distance of about 70 miles. A 2% tax has been voted through the different townships, and right of ways secured almost along the entire line. F. L. Patrick, Columbus, O., the president of the company has been at Rockport, Ind., for some time. We cannot tell when the construction contracts will be awarded. The reported construction companies mentioned must have given up their contracts if they had taken same. The road will run through no principal cities of interest, but does give a direct connection with Chicago and the East and West. Several railway men are now in town going over the line and figuring on taking contracts, but as yet we know nothing of what they have done or intend to do. The tax has been voted over two years, and the project has had many ups and downs, and owing to the financial stress we as yet have had no certainty of the road. The intention of the company is to push into the South; to build a bridge at this place and to build through to Chattanooga.——Press reports continue to state that the contracts for building this road, at least a portion of it, have been awarded. Ch. Engr., C. H. Wright, 723 Rookery, Chicago.

PORT COLBORNE & FORT ERIE.—This company has been provisionally organized; directors, William M. German, M. P. P., Welland; R. G. Cox, St. Catharines, Ont.; Eugene Coste, Buffalo, N. Y.; A. I. Holloway, Buffalo, N. Y.; D. McGillivray, L. McGlashan, and Thomas F. White, Port Colborne. It is stated that as soon as the Ontario Legislature grants a charter active operations will begin.

RUMFORD FALLS & RANGELEY LAKES.—R. B. Stratton, Ch. Engr., Rumford Falls, Me., was to commence last week, according to press reports, on the preliminary survey for the extension of this railway from Houghton to Bemis, about 10 miles from the terminus of the line now building; also for several short branches.

WISCASSET & QUEBEC.—The stockholders of this company have voted to issue $400,000 in bonds to build the road to Burnham, Me., and to a connection with the Bangor & Aroostook and Canadian Pacific roads.

Southern.

DUBLIN & COLDWATER.—This company is reported about to build a lumber railway about six miles in length, with a possible extension of an additional 15 miles. The Southern Equipment Co., Memphis, Tenn., has the contract for the rails and equipment. R. H. Wildberger, of Clarksdale, Miss., is interested.

EAST & WEST ALABAMA.—Press reports from Birmingham, Ala., state that C. A. Avery, representing the Columbian Equipment Co., of New York, which has bought the Birmingham Belt Line for terminal facilities for the East & West, also purchased by it, states that the work of completing the East & West to Birmingham from Pell City, Ala., will begin on Feb. 1. Mr. Avery is also quoted as stating that the Seaboard Air Line would build from Atlanta to the Eastern terminus of the East & West at Cartersville, Ga., and that the Seaboard Air Line stockholders will meet in Baltimore with the Columbian Equipment Co. for the purchase of the East & West. This means a continuous trunk line for the Seaboard Air Line from Birmingham to New York.

NORTHERN NECK.—The organization of this company, with the names of the officers, was noted last week. A correspondent sends us the following additional information: The $100,000 of the capital stock, as required by the laws of Virginia, was subscribed by New York and New England capitalists, and work will begin on the road at once. A preliminary survey is now being made by a corps of engineers, with William A. Hankins, of Hankins, Mosby & Co., Richmond, Va., in charge. The Northern Neck of Virginia, as it is termed, lies between the Rappahannock and Potomac rivers, embracing the counties of Stafford, King George, Westmoreland, Richmond, Lancaster and Northumberland, and has no railway facilities whatever. The length of the road from Fredericksburg to the Chesapeake Bay will be about 90 miles and will follow the ridge of the Northern Neck nearly the entire length of the road, passing through the towns of Comorn, King George, Montross, Warsaw, Heathsville, Lancaster, with the Eastern terminus at Millenbeck, where a harbor sufficient to float the largest ships afloat is found. There will be one steel bridge, about 800 ft. in length, over the Rappahannock at Fredericksburg and several short plate girder bridges between Fredericksburg and the Eastern terminus. The road will be standard gage of the very best construction, using 76-lb. steel rails and white oak and heart cypress ties. All structures will be made permanent and masonry will be constructed for a double track. This road will be equipped in first-class manner and promises to be one of the leading railways of the state, as it has plenty of capital to build the road and whatever extension may be contemplated in the future. It is the intention of the company to have the road completed by the fall of this year.

SOUTH BOUND.—This company is reported about to build a new bridge at Columbia, S. C., and enter the city by a new route.

VIRGINIA.—A correspondent writes us as follows: A railway is projected from tidewater in Virginia to Charleston, W. Va., via Harrisonburg, Va. The road will cross the great Shenandoah Valley at its widest and extend to the coal regions of West Virginia and will develop one of the greatest timber and coal regions in Virginia. It is expected that work will begin within 30 days on the line between Elkton and Bridgewater, Harrisonburg being the central point. The enterprise is backed by New York and Boston capitalists, P. S. Thomas, of Harrisonburg, Va., can give information.

Northwest.

DUBUQUE, KANSAS CITY & SOUTHWESTERN.—Efforts are being made to secure the construction of this railway from Dubuque to Maquoketa, and possibly to build from Bernard to Gladbrook. The road would probably be leased by the Chicago & Northwestern. Pres., B. J. O'Neill, Dubuque, Ia.

MINNEAPOLIS, ST. PAUL & ASHLAND.—This company has been organized by C. H. Pratt, of Minneapolis, and others, to build a railway from Ashland, Wis., via Namekagon Lake and Shell Lake to St. Croix Falls, Wis., where it will connect with the Soo Line and the St. Paul & Duluth, a distance of about 125 miles; directors, Judge J. W. Cochran, E. A. Shores, Thomas Bardon, D. W. Mowatt, S. S. Fifield, W. R. Sutherland, Dr. Edwin Ellis, Ashland; John W. Perley, St. Croix Falls, Wis.; R. L. McCormick, of Hayward, Wis.; William R. Bourne, Shell Lake, Wis.; S. G. Cook, C. H. Pratt, P. D. McMillan, Minneapolis; A. R. McGill, St. Paul.

Southwest.

CHICAGO, KANSAS & ARKANSAS.—Incorporated in Kansas to build a railway from Doniphan, Kan., to Little Rock, Ark.; capital stock, $3,000,000; incorporators, Chas. N. Hale, Richard E. Breed, Jos. Foster, of Chicago; T. J. Porter, Ned D. L. Biles, St. Joseph, Mo.; Geo. Brenner, N. G. Brenner, Doniphan, Mo.

CHICAGO, ROCK ISLAND & PACIFIC.—A press report states that this company will, during the coming year, extend its tracks southward from Liberal, Kan., down through No Man's Land, crossing the Denver, Texas & Fort Worth line at or near Duncan, Tex., thence on to Fort Sumner on the Pecos River, and then to the white oaks country and Fort Stanton. At this latter place a connection will be made with a

line to be constructed from El Paso along the east range for a distance of about 150 miles. This extension will make a short line to El Paso, where a connection will be had with the Mexican Central, and give the Rock Island the shortest line between the east and the city of Mexico.

CORSICANA & SOUTHEASTERN.—The contract for constructing this railway was awarded several months ago, but it is stated that the work was abandoned for lack of capital. Press reports state that E. H. R. Green, Pres. Texas Midland, is considering the purchase of the road, and its completion to Sabine Pass.

GULF & INTERSTATE OF TEXAS.—The contract for completing the first six miles of this railway out of Bolivar Point is reported to have been awarded, the rails to be delivered by Feb. 10, and it is stated the first 30 miles of the road out of Beaumont will be completed by June 1.

LA PORTE, HOUSTON & NORTHERN.—This railway was noted in our issue of last week. A correspondent writes us as follows in regard to the work: The consolidation of the La Porte, Houston & Northern, the North Galveston, Houston & Kansas City, and the Houston Belt and Magnolia Park railways has been perfected, and the contract let for the completion of the through line, which will be operated under the name of the Galveston, La Porte & Houston R. R. L. J. Smith, a well-known railway contractor of Kansas City, Mo., has secured the contract, and will begin active work at once, the road from Houston to Virginia Point to be completed within 90 days. The contract includes a new bridge across Galveston Bay, and terminal facilities in the city of Galveston, to be completed by July 1, 1895. This new combination forms the much needed third line between Houston (the greatest railway center of Texas) and Galveston, the deep-water port, and will furnish ample terminal facilities both at Galveston and La Porte for the lines that seek a tide-water outlet.

MISSOURI.—An occasional correspondent (who will favor us by sending us his full address) writes us that the Ware, Way & Peck Construction Co. has been awarded the contract for building an extension (name of road unknown) from Ruber Place to Fenton, Mo., a distance of eight miles. The work will be quite heavy, one section containing 48,000 cu. yds. mostly solid rock. The right of way is all secured, and the construction will be commenced at once. The work will require a trestle over the River Desperes.

PORT BOLIVAR, GALVESTON & VIRGINIA POINT.—Incorporated in Texas to construct terminal facilities at Virginia Point and Port Bolivar and build a railway bridge across Galveston Bay; capital stock, $500,000; incorporators, F. P. Nichols, C. Van Sickle and W. S. Jones, and others, of Galveston.

ST. LOUIS, KENNETT & SOUTHERN.—The extension of this railway into Pemiscot county, Mo., has been completed to Caruthersville. The extension is 25 miles in length. Pres., Louis M. Houck, Cape Girardeau, Mo.

WATHERFORD, MINERAL WELLS & NORTHWESTERN.—Press reports state that this railway will be extended in the spring from Mineral Wells to Graham, Tex., and then through to Fort Worth and to coal fields in the Northwest.

Rocky Mt. and Pacific.

COLORADO, GREAT NORTHERN & WYOMING.—The incorporation of this company by the directors of the narrow-gage Little Book Cliff Ry. was noted in our issue of Nov. 15. Press reports state that $3,000,000 in bonds have been negotiated to build the proposed road from Grand Junction, Colo., to Green River, Wyo., on the Union Pacific, and that surveys are now in progress. Pres., W. T. Carpenter, Grand Junction, Colo.

SAN PETE VALLEY.—A correspondent writes us as follows: The preliminary survey for the extension to Salt Lake City was completed on Jan. 8, by O. R. Young, Ch. Engr. The party was out just two months and ran over 150 miles of line in all. The distance by the proposed line from Moroni to Salt Lake City is 111.6 miles, practically the same as at present by connection with the Union Pacific at Nephi. The line from Moroni to Nephi, the present northern terminus, is 24.3 miles, of which 11.2 is over the operated narrow-gage line, the remainder being new construction. The maximum grades on the east side of the summit in San Pete valley for the operated and proposed lines, respectively, are 83 and 75 ft. per mile; on the west side in the Salt Creek Canyon are 190 ft. and 132 ft., respectively. The maximum grades of 2½% for the new line are properly compensated for by the curvature. From Nephi to Salt Lake City the maximum grade north is +0.8%, the maximum grade south +1.0%. With the exception of two or three curves of 9° or 10° in Salt Creek Canyon, the maximum curves will be 4° to 5°. The general route from Nephi to Salt Lake City is near to that of the Union Pacific. The extension is intended primarily for hauling coal from the company's mines at Morrison, the present southern terminus, and the line strikes most of the towns along the route nearer their business centers than the Union Pacific in order to supply the coal trade. The line crosses the Rio Grande Western main line at Springville, and the Alta branch of the same at Bingham Junction. The Union Pacific is crossed at American Fork and at Bingham Junction, while the Tintic branch of the same is crossed overhead near Lehi Junction. The line runs through the Jordan Narrows close to the Rio Grande Western, and, like it, is quite direct from there to Salt Lake City. The Jordan River is crossed twice in the Narrows. The line enters Salt Lake City on 2d West St., ending at 3d South St. Theodore Bruback is president and H. S. Kerr, superintendent of the company. The general offices are at Salt Lake City, and the local headquarters at Manti, Utah.

STREET AND ELECTRIC RAILWAYS.

AUGUSTA, ME.—W. A. Roberts and Edgar A. Hubbard are among the incorporators of the York County Electric Ry. Co., noted in our issue of last week.

MANCHESTER, N. H.—Press reports state that if the applications for charters now pending in the legislature are granted, Manchester will soon be gridironed with electric railways. One of the most important charters asked for is for the cross-town and belt line electric railway. The capital stock of this company will be $500,000, which will be bonded. The incorporators are Charles T. Means, George S. Eastman, D. A. Taggart, W. S. Pillsbury, and others, of Manchester; W. R. Brown and H. L. Johnson, of New York; John F. Stark, of Nashua; Akerman O. Worcester, of Litchfield, George W. Mansfield, of Norwalk, Conn., and A. M. Brown, of Worcester.

BOSTON, MASS.—Press reports state that the Meigs Elevated R. R. Co. has filed a list of locations of its proposed lines of rapid transit, as noted in our issue of Jan. 17.

EAST WEYMOUTH, MASS.—The Quincy & Boston St. Ry. Co. has petitioned for a franchise for its electric line on Pleasant St. to South Weymouth. The company has purchased some property on Broad St., and it is reported will soon build a car house.

NEWBURYPORT, MASS.—Press reports state that a meeting of those interested in the building of the Essex County St. Ry., under the legislative act of 1893, will be held at Ipswich this week. The incorporators represent the business interests of Newbury, Rowley and Ipswich, the three towns through which the line will pass. It is anticipated that work will be commenced early in the spring. The line would be a continuation of the Newburyport & Amesbury Ry., which now runs to Parker River in Newbury. With the line completed to Ipswich, and only a break of nine miles to the Naumkeag railway at Hamilton, it would not be long before the chain would be complete between Newburyport and Boston. This is a step toward the proposed consolidation of the electric railways of eastern Massachusetts, including the Lynn & Boston, Naumkeag of Salem, the Essex County St. Ry., Newburyport & Amesbury, Haverhill, Merrimac & Amesbury and Lowell & Lawrence. These roads have a capitalization of $2,000,000, and operate fully 150 miles of track.

NEWTON, MASS.—The Newton St. Ry. Co. has petitioned for a franchise to extend its electric line in Newton, Watertown aand Waltham.

WAKEFIELD, MASS.—The Wakefield & Stoneham St. Ry. Co. has voted to extend its electric line from Reading to Stoneham, a distance of about three miles. Work will probably begin in the spring. Gen. Man., C. F. Woodward.

BINGHAMTON, N. Y.—The Binghamton, Lestershire & Union Electric Ry. Co., recently incorporated, has been granted a franchise for its line from Lestershire to Union. Work will probably begin in the spring. It is reported that there is talk of repairing an old dam on the Susquehanna River above the Union bridge, for the purpose of furnishing power.

GENESEO, N. Y.—Press reports state that the proposition to build a six-mile electric railway from Geneseo to Long Point, on Conesus Lake, to be used during the summer camping and excursion season, is being considered by the citizens and the Geneseo Electric Light Co., which has more power at its well-equipped plant than is necessary for lighting the streets and other purposes.

NYACK, N. Y.—The Nyack Traction Co. has petitioned the South Nyack board for a franchise for its electric line on Franklin St.

WATERPORT, N. Y.—The Waterport Electric Light & Power & R. R. Co. has been incorporated to succeed the Waterport Electric Light & Power Co., recently incorporated, and to build a line of the Beecher single-rail railway from this place to Lakeside, on Lake Ontario, a distance of four miles; capital stock, $40,000; directors, Lina Beecher, C. A. Seaver, and E. C. Long, of Batavia, and D. D. Bromley, of Waterport.

WHITE PLAINS, N. Y.—The Westchester County Central Electric Ry. Co. has been incorporated to build a line in this place and to Harrison, a distance of three miles; capital stock, $75,000; directors, Chas. A. Johnson, Fred. H. Reed and Lloyd McK. Garrison, of New York; S. H. Gainsburg and E. C. Sniffin, of White Plains, and Geo. W. Mansfield, South Norwalk, Conn.

FREEHOLD, N. J.—It is reported that an electric railway will probably be built between this place and Asbury Park and if it is found advisable the line may be extended to Trenton.

HOPATCONG, N. J.—A correspondent writes us that the Hopatcong Transportation & Power Co., formerly the Hopatcong Steamboat Co., has increased its capital stock from $20,000 to $100,000, to build early in the spring an electric railway from the Delaware, Lackawanna & Western station along the east side of Lake Hopatcong. The survey has been already made. Pres., Theo. F. King, of Landing, N. J.; Secy., O. F. G. Megil, 87 Nassau St., New York.

PATERSON, N. J.—Frank E. Rea is reported as interested in the construction of an electric railway to North Paterson.

SOMERVILLE, N. J.—Press reports state that the Philadelphia & New York Traction Co. has begun work toward the construction of its electric line. It has commenced in a preliminary way between Bound Brook and Somerville. Poles are being placed in position and some filling in is being done preparatory to building bridges. The right of way has now been obtained from Raritan to Dunellen, and from Bound Brook to Trenton, with the single exception of Princeton. The trouble which was reported to exist in the company was in reference to contracts and has all been adjusted. It is said that Hillpot & Ayres are to build the Bound Brook and Raritan spur.

TRENTON, N. J.—The Trenton Passenger Ry. Co. has petitioned the Princeton authorities for right of way through that place. The company is planning to extend its electric line to Bordentown, according to reports. Secy. and Treas., John L. Kuser.

CHESTER, PA.—Press reports state that the Media, Middleton & Aston Trolley Co. paid to the council and the supervisors of Chester county $4,100 for a right of way through the two places. It is the intention of the company to award the contract for the construction of the line soon. It will be the third railway to enter Chester. People now have to go by way of Philadelphia or Media to reach many of the small towns.

LANCASTER, PA.—It is stated that S. M. Patterson, Pres. Pennsylvania Traction Co., proposes to take out a charter soon for an electric railway from West Chester to Unionville, thence to Kennett Square, Toughkenamon, Avondale, West Grove and Oxford. This line will not be connected in any way with the Pennsylvania Traction Co., but will be constructed by New York parties. A number of local capitalists will be invited to lend their assistance to the scheme.

PHILADELPHIA, PA.—Press reports state that George Lodge, Gen. Man. E. M. Underground Ry. Co., has purchased a plot of ground at 24th St. and Sedgley Ave., on which the equipment works of the new system will be erected. The plot contains nearly two acres, and was bought from Henry Rubland for $20,000. Contracts for the new buildings will be let in a few days.

POTTSTOWN, PA.—The Schuylkill Electric Ry. Co. will extend its line to Pottsville, St. Clair and through a part of the Heckscherville Valley and construct a power house estimated to cost $100,000, next summer, according to reports. The company proposes to increase its capital stock from $150,000 to $650,000. T. F. Connell is contractor for all the improvements. Pres., C. H. Barritt, Philadelphia.

SCOTTDALE, PA.—Press reports state that the council has granted the right of way over Broadway, Market, Pittsburg and Mulberry Sts. to the Scottdale, Everson & Broadford Electric St. Ry. Co., and the company proposes to commence the construction of the line at an early date.

BALTIMORE, MD.—The Baltimore, Middle River & Sparrow's Point R. R. Co., represented by Thos. B. Gatch and James Gilmore, has petitioned the Baltimore county commissioners for a franchise for its electric line on several roads to connect with the City Passenger Ry. at Tome St. and Third Ave., and with the Baltimore Traction Co.'s line at Fayette St. Engr., Chas. B. McClean.——The City & Suburban Ry. Co. has voted to increase the capital stock from $3,000,000 to $4,000,000 to extend its electric line to Catonsville along the Frederick turnpike and its Point Breeze line across Colgate Creek, and ultimately to Sparrow's Point. Permission has been obtained to build a bridge across this creek, and the plans for the bridge have been prepared by Frederick H. Smith. It will be 1,600 ft. long and of pile construction. The draw will span the channel of the creek and will be of steel. On the east side of Colgate Creek at St. Helena the City & Suburban Co. has purchased a tract of about 16 acres. This, it is said, will be used for erecting repair shops and other buildings. The building of the proposed extension on Wolfe St. from North Ave. to the water front and on Eager St. from Park Ave. to Wolfe St. is also expected to begin as soon as the ordinance granting this privilege is passed by the council and signed by the mayor. The most important change contemplated in connection with the consolidation of the City & Suburban and Lake Roland Cos., Feb. 1, is the building of a double track out West North Ave. to Walbrook. This line now has a single track west of Pennsylvania Ave. and the track is on the south side of the avenue. The present track will be put in the middle of the avenue and an additional track laid beside it. With the completion of this work the City & Suburban cars will make a continuous run from the corner of North Ave. and the Belair road to Walbrook. Pres., Nelson Perin.

BALTIMORE, MD.—Arrangements have been completed for the construction of the Baltimore & Washington Boulevard Co.'s proposed standard gage electric line between these cities, a distance of 32 miles. The entrance into Washington has been about obtained. An option has been secured on the old Washington baseball grounds, at F and North Capitol Sts., which are to be used for building the terminals. The company will issue $5,000,000 in stock and $5,000,000 in bonds. Permission has not yet been granted from the council for the entrance into this city, but as soon as it is secured the work of construction will commence. Contracts have been awarded for the grading, masonry work and bridges from the District line to Laurel. The contracts for the remainder of the work will be given out as soon as the needed privileges are obtained in Baltimore. The whole line will be double-tracked, laid with heavy steel rails and ballasted with stone. All the bridge work will be of iron and steel. Officers of the construction company which is to build the line are: Pres., Bernard N. Baker; Vice-Pres., John Hubner; Secy and Treas., George Yake. These officers, with Robert Carswell and David M. Newbold, form the board of directors.

WASHINGTON, D. C.—A bill has been introduced into the House to incorporate the Washington & Brighton Ry. Co. to build an electric line from New York Ave. and Florida Ave. to a point on Chesapeake Bay in Calvert county, Md.; incorporators, Horatio Browning, Clarence F. Norment, Levi Woodbury and F. P. May.——It is reported that the car station of the Brightwood Ry. Co., at Brightwood Park, a suburb of Washington, was burned Jan. 25; 14 electric cars were consumed; loss, $30,000; partly covered by insurance. Supt., C. P. Williams.

ANNISTON, ALA.—Press reports state that a movement is being made to connect Anniston with the Coosa River and the St. Clair county coal fields just beyond, a distance of about 20 miles, by an electric railway, the shoals on the river to be harnessed for the purpose of furnishing the electricity. A route was surveyed some time since, and a company will probably be organized in a few days to build the line.

COLUMBUS, GA.—The Drake & Stratton Co. has been granted a charter for an electric railway across the 14th St. bridge to Sommerville Hill and Phenix City, according to reports, and the surveys have been made.

TAMPA, FLA.—The Palmetto Beach Ry. Co. has been granted a franchise for its street railway on several streets.

NEW ORLEANS, LA.—The commissioners of the lower city park are discussing the construction of an electric railway through that portion of the city. Geo. H. Grandjean is interested. John B. Cefalu, Secy. Park Com.

LONG BEACH, MISS.—The Gulf Coast Electirc R. R. Co. has been granted a charter for a line from Pass Christian to Biloxi, a distance of about 20 miles. James B. Cable, G. W. Bennett, of Long Beach, and A. M. Dahlgren, Biloxi, are interested.

CINCINNATI, O.—The Mount Adams & Eden Park Inclined Ry. Co. has increased its capital stock from $2,000,000 to $2,500,000. Supt., John C. Weaver.

CLEVELAND, O.—It is claimed that the proposed electric railway between Cleveland and Elyria, a distance of 25 miles, will be built in the spring. The tracks of the Berea St. Ry. Co. will be used for a distance of nine miles, which necessitates the construction of but

16 miles of line. Pres., A. H. Pomeroy, Berea; Secy., A. E. Akins; Treas., F. T. Pomeroy, Cleveland.

HARTWELL, O.—The council has not received any bids for the construction of an electric railway to Cincinnati. Instead, communications were sent in from the Cincinnati, Dayton & Middletown Traction Co., and the Cincinnati Inclined Plane Ry. Co. The former stated that it would not make any bid until the Paddock road improvement had been completed; while the latter stated that it would have to wait until the matter of the franchise, which is now pending in the courts, is settled. These two companies asked the council to defer action in the matter until they can send in bids.

LIMA, O.—A correspondent writes us as follows: The Lima Electric Ry. Co., on Jan. 11, sustained the loss by fire of its entire equipment, consisting of barn and seven cars, office furniture, etc. The fire occurred after the last car had been run in for the night. Loss, $25,000, partly covered by insurance. The system will be re-equipped at once with new and latest improved cars throughout. Pres., A. E. Townsend, of Pittsburg.——The College Hill Electric Ry., under construction, is now ready for and awaiting the arrival of iron. Gen. Man., Geo. H. Melly, of Lima; Engr., R. H. Gamble; Galarneau & Latham are the contractors.

MOUNT VERNON, O.—The Mount Vernon Electric Ry. Co. is reported as to extend its line to several sections of the town in the spring. Gen. Man., P. B. Chase.

SPRINGFIELD, O.—C. S. Courson has been granted a 25-year franchise for an electric railway from this city to Clifton and Cedarville.

WELLSTON, O.—The Wellston & Jackson Belt Ry. Co. has been incorporated to build an electric line between Wellston, Jackson, Hamden, McArthur, with branches to Vinton, Akin's Mill, California and Wilkesville; capital stock, $500,000; incorporators, Harvey Wells, J. C. Clutts, Chas. L. Currier and A. D. Lutz.——The Jackson, Wellston & McArthur Ry. Co. has been incorporated to build an electric line to the same cities as the above company, but without the branches; capital stock, $10,000; incorporators, Isaac E. Adams, Daniel J. Ryan, Edwin R. Sharpe and Edward B. McCarter.

ANDERSON, IND.—Press reports state that the work of surveying the right of way and setting stakes for Charles L. Henry's Gas Belt Electric Ry. began Jan. 22. Wayne Choate, of Detroit, is superintending the work between this city and Alexandria, and will follow that with the survey to Indianapolis. The line between Marion and Indianapolis is to be built first. The entire line between Marion and Indianapolis, a distance of 80 miles, will be in operation by September.

GRAND HAVEN, MICH.—Geo. W. Jenner has been granted a franchise for an electric railway.

PAW PAW, MICH.—Glidden & Cunningham, of Detroit, are interested in the construction of an electric railway between here and Lawton.

SAGINAW, MICH.—Lionel S. Pardee, of Akron, O., and George Silsby have been securing right of way for an electric railway to connect this city with Bay City.

CHICAGO, ILL.—The Chicago Belt Line St. R. R. Co. has been incorporated, with a capital stock of $500,000, by F. J. Phillips, G. F. Loehr and Andrew Matson.——The committee on streets and alleys has voted to recommend an ordinance for the construction of an electric railway by the West Chicago St. R. R. Co. on Van Buren, 21st, Loomis, Lincoln and other streets in the business portion of the city. ——The General Electric Ry. Co. has been incorporated with a capital stock of $5,000,000, to build a line on the plans of a new and improved underground electric system recently invented by Henry Bradenburg. Chas. T. Yerkes is reported as interested.

ROCKFORD, ILL.—Press reports state that Chicago and Minneapolis capitalists are considering the construction of an electric railway from Harvard to Delavan, Wis., by way of Walworth, Fontana and Geneva Lake. Wisconsin farmers will grant right of way, and Illinois farmers will probably do the same. The line will connect with the Chicago, Milwaukee & St. Paul Ry. at Delavan.

NEBRASKA CITY, NEB.—The Nebraska City St. Ry. Co. is securing estimates for the equipment of its line with electricity and extending it to Kearney, Greggsport and Prairie City. Secy., John C. Watson.

OREGON, MO.—L. I. Moore is interested in a project for an electric railway between this place and Forest City, estimated to cost $40,000 to $60,000. It is probable that work will commence as soon as the council grant the necessary franchise.

ST. LOUIS, MO.—The Florissant Horse Ry. Co. has petitioned for a charter, and as soon as it is granted work will commence. The line is to be constructed mainly to develop the property owned by the Walnut Hill Improvement Co.; Pres., Theodore P. Bell.

FORT WORTH, TEX.—The Fort Worth St. Ry. Co. has increased its capital stock from $50,000 to $100,000.

CORSICANA, TEX.—Press reports state that an eastern syndicate has made the citizens of this city a proposition through Capt. J. A. Townsend to build an electric railway here at a cost of $15,000, providing liberal franchises are granted.

SAN ANTONIO, TEX.—It is reported that S. P. Maury, of the San Antonio Club, has asked for bids for an electric motor to haul an 80,000-lb. car over a 2% grade, standard-gage railway, with sharp curves.

MONTREAL, QUE.—The Montreal Park & Island Ry. Co., Gen. Man., J. R. Thibaudeau, and the Montreal St. Ry. Co., Supt., J. J. Franklin, have petitioned for franchises on Mount Royal.

AYLMER, ONT.—An electric railway is to be built between this place and Hull in the spring. It is reported that Theophile Vian, the projector, has purchased about 19,000 ties.

GALT, ONT.—The Galt & Preston St. Ry. Co. proposes to extend its line from Preston to Hespeler. Pres., Thomas Todd.

HAMILTON, ONT.—Press reports state that another radial railway, with Hamilton as its principal point, is projected. Crerar, Crerar & Bankier, of this city, have made application to the legislature for permission to build an electric railway, to be known at present as the Hamilton, Valley City & Waterloo Ry. The route of the line will be through the townships of Barton, Ancaster, West Flamboro and Beverley, Wentworth county, and on to Waterloo. The company also asks for authority to operate a branch line from West Flamboro or Beverly to Guelph.

ELECTRIC LIGHT AND POWER.

CARIBOU, ME.—J. A. Clark has petitioned for permission to amend the charter of the Caribou Water Co. for the purpose of furnishing electricity to Washburn and Presque Isle.

MORRISVILLE, VT.—Bids are asked until Feb. 9 for the purchase of $45,000 of 4% electric light and water bonds.

READSBORO, VT.—Press reports state that P. G. Carpenter, of North Adams, Mass., has sold to W. S. Kelley, of the General Electric Co., Howes pond and over 500 acres of land in this town. It is believed that the company will build a large electric plant there.

BLACKSTONE, MASS.—R. Schefbauer, Paterson, N. J., has offered to put an electric plant of 29 lights in this place at 40 cts. per light per night, the town to have an option to buy the plant after one year.

QUINCY, MASS.—It is reported that the question of establishing a municipal electric light plant is being discussed.

WALLINGFORD, CONN.—It is reported that this place has voted to put in an electric light plant.

BUFFALO, N. Y.—The Niagara Falls Power Co. and the Niagara Falls Hydraulic Power & Canal Co. have petitioned for franchises.——The Cataract Construction Co. has been granted a strip of land 30 ft. wide between Buffalo and Tonawanda for its poles, etc.

EATON, N. Y.—It is reported that one of the latest projects is the establishing of an electric light plant at Pierceville, where there is an excellent water power, and furnishing of light to this town, West Eaton and Morrisville.

ALLEGHENY, PA.—The Western Electric Co., of Chicago, is reported to have been awarded the contract for extending the municipal electric light plant.

OXFORD, PA.—Press reports state that it is probable a company of Philadelphia capitalists will erect an electric plant at Pine Grove, on the Octoraro Creek, about three miles west of Oxford. Lewis E. Pennock has examined the ground, and estimates there is water power sufficient to generate 1,000 to 1,400 HP. It is proposed to erect the plant just below the intercounty bridge. It will be a rival to the Oxford Electric Light Co.

ELKTON, MD.—Press reports state that a preliminary movement has been made toward establishing an electric plant on the Octararo and using the water power of Joseph Richards at Porter's Bridge. This is said to be one of the best water powers on the creek, having a fall of about 40 ft. with a very moderate dam. There is sufficient power at that place to furnish light and electricity for machinery to all places within a radius of four miles.

SMITHVILLE, GA.—It is reported that this place will have an electric light plant to be operated by water power.

DE LAND, FLA.—John B. Stetson has been granted a franchise for 15 arc lights at $1,000 per year.

TROY, ALA.—Bids are asked for a Corliss 125 to 150-HP. compound condensing engine and a 600 to 1,000-incandescent light dynamo. L. E. Gellerstedt, Chn. Fire and Water Com.

JACKSON, TENN.—The Jackson & Suburban St. R. R. Co. has been granted a franchise for constructing an electric light plant. Pres., J. H. Hunter.

SHELBYVILLE, TENN.—An electric light plant for both arc and incandescent lights is to established in connection with the water-works, which are to be constructed by the Pittsburg Water-Works & Construction Co.

LOWELLVILLE, O.—Wm. L. Erskine, Clk., writes us that the mayor has been directed to call an election to vote on the question of issuing $8,000 in bonds for an electric light plant.

CARBON, IND.—Fox Bros. have petitioned for a franchise for an electric light plant.

LAFAYETTE, IND.—Bids are asked until Feb. 15 for wiring the Second Presbyterian Church for electric lighting. W. K. Eldridge, Supt., Court House.

CHELSEA, MICH.—Press reports state that a proposition is now being considered which provides for 20 arc lights at $1,680 per year, the lights to be 2,000 c.p., and the contractors to furnish all the accessories. This proposition will undoubtedly be submitted to a vote of the people.

GALESBURG, MICH.—Press reports state that two propositions for electric lighting are being considered. One provides 30 lights at $500 per year, the contractors to furnish all the accessories. The other is to bond the village for the necessary amount, thus giving the corporation entire control. The latter is regarded with the greater favor.

IMLAY CITY, MICH.—It is reported that the council has entered into a contract with F. E. & H. Hatch, an electric light firm of Detroit, for a system of eight arc lights.

OXFORD, MICH.—Bids are asked until Feb. 11 for the purchase of $6,000 in 5% electric light bonds. Robt. Marshall, Village Clk.

MAYWOOD, ILL.—The Maywood & Proviso Electric Light & Power Co. has petitioned for a franchise.

MILLSTADT, ILL.—It is reported that an electric light plant is to be put in.

PARIS, ILL.—The water supply at this place is deficient, and steps will soon be taken toward building a new power house, according to reports.

CLINTONVILLE, WIS.—Press reports state that D. S. Stewart has been granted a 20-year franchise for an electric light and power system, and has organized the Clintonville Electric Light & Power Co., which will soon begin operations upon a plant. Steam power will be used at present, but Mr. Stewart has an option upon a water power 10 miles from town, which he will undoubtedly purchase.

FOX LAKE, WIS.—The question of an electric light plant is being discussed.

OSHKOSH, WIS.—It is reported that the Central Wisconsin Electric Ry. Co. has been formed to build a line between Oshkosh and Kaukauna; capital stock, $1,000,000; it is thought that the line will be in operation by June 15. Directors, Geo. H. Ketcham, Toledo, O.; Geo. J. Robush, St. Louis; T. E. Ryan, Waukesha, Wis., and M. L. Campbell, Neenah, Wis. James K. Tillotson, of Toledo, O., is interested.

OREGON, MO.—The Mayor is considering a proposition for an electric light plant, according to reports.

YUMA, ARIZ.—George Mittendorf, of Prescott, is reported as interested in organizing an electric light company for this place.

ANDOVER, N. B.—Edward Jack has petitioned the council for permission to lease the commons at Grand Falls to the Grand Falls Water-Power Co. to utilize the falls. The council voted to grant the permission if $10,000 was spent in surveys and improvements.

VANCOUVER, B. C.—The council has received the following propositions for the proposed leasing of the electric light plant: A. E. Williams offers to operate the plant, furnishing all materials and labor, with an all-night service of street arc lights, and furnish an engineer for the fire engines, at $490 per month, the city to collect all revenues from the sale of lights; Jenkins & Harvey propose to lease the plant outright for five years, furnish all material and help, furnish an engineer for fire engines and to collect all revenues, and to maintain 50 arc lights for streets at a monthly rental to the city of $2.50 each. Extensive repairs will have to be made to wires, poles and machinery, according to reports.

NEW COMPANIES.—Nikola Tesla Co., New York, N. Y.; $5,000; to manufacture machinery, generators, motors, and electrical apparatus; Edward D. Adams, Alfred S. Brown, New York; Chas. F. Cooney, Summit, N. J.

Garrett Electric Light Co., Garrett, Ind.; $20,000.

Citizens' Electric Light & Power Co., Hughesville, Pa.; J. K. Rishel, James K. Boak, Milton Bodine.

Clinton Water & Electric Co., Clinton, Me.; $100,000; A. Rowell, S. P. Felker, B. P. Porter, W. T. Haines.

E. S. Karoly Electrical Construction Co., Chicago, Ill.; $12,000; E. S. Karoly, V. Merriman, J. H. Weber.

Rawson Electric Co., Elyria, O.; $50,000; H. C. McKinley, J. B. Coffinberry, T. M. Brush, S. B. Rawson.

Grand Island Light & Power Co., Grand Island, Neb.; $50,000; H. T. J. Fuehrman, Henry C. Joehnk, W. H. Thompson.

Franklin Electric Illuminating Co., Sea Cliff, N. Y.; $20,000; Pres., Dwight W. Pardee; Treas, John Graham; Secy., F. J. Coles.

Boynton Multivolt Battery Co., Brooklyn, N. Y.; $10,000; to manufacture batteries and electrical apparatus, photographic supplies, and materials; Edward Boynton, Brooklyn; Abraham Strauss, Chas. H. Brigham, New York.

American Bureau of Electrical Engineering, Information and Employment, Chicago, Ill.; $1,000,000; to conduct a bureau for electrical engineers; Clinton E. Woods, Francis E. Drake, P. Malden.

Snoqualmie Falls Electric Power Co., Seattle, Wash., and New York, N. Y.; $2,000,000; to furnish electricity to Seattle and the counties of King, Pierce and Snohomish, to be generated at the Snoqualmie Falls; Smith M. Weed, Chas. D. Wells, New York; D. H. Gilman, Watson C. Squire. Seattle.

BRIDGES.

CHELSEA, MASS.—The city has petitioned for legislation to compel the Boston & Albany R. R. Co. to build an overhead bridge over its tracks on Matthews St.

LOWELL, MASS.—A bill has been introduced in the legislature authorizing the construction of a bridge between Pawtucket Falls and Tyngsboro.

PROVIDENCE, R. I.—The secretary of war has approved an appropriation of $40,000 to enlarge the Old Colony railway bridge draw and to deepen the stream to 25 ft. at Sakonet River.

BUFFALO, N. Y.—The board of public works opened the following bids Jan. 22 for the construction of the proposed iron bridge over the Scajaquada Creek on Niagara St.:

Buffalo Bridge & Iron Works, Buffalo	$6,850
Nelson & Buchanan, Chambersburg, Pa.	6,960
King Bridge Co., Cleveland, O.	6,234
Owego Bridge Co., Owego, N. Y.	7,600
Buffalo Structural Steel Works, Buffalo	6,195
Berlin Iron Bridge Co., East Berlin, Conn.	8,200
Wrought Iron Bridge Co., Canton, O.	6,130
New Jersey Steel & Iron Co., Trenton, N. J.	7,953
Kellogg Steel & Iron Co., Buffalo	7,033
P. H. Marburg, Buffalo	5,812
Massillon Bridge Co., Massillon, O.	10,870
Groton Bridge Co., Groton, N. Y.	12,688
Toledo Bridge Co., Toledo, O.	10,990

CITY ISLAND, N. Y.—It is reported that the recommendations of J. Henry Carpenter, Engr. to the board of supervisors, in the matter of building a bridge at this place between the Westchester and New York county lines will probably be approved. The work will cost about $100,000.

LITTLE FALLS, N. Y.—A bill has been introduced in the legislature appropriating $25,000 for new bridges on German and Bellinger Sts.

OAKMONT, PA.—The Verona Bridge Co. has been incorporated with a capital stock of $1,000 to construct a bridge over the Allegheny River at this place. Treas., Stephen B. Clement; directors, H. S. Paul, Caleb Lee, J. G. Emerick, Oakmont.

PITTSTON, PA.—Scoville's Island, situated in the Susquehanna River opposite the West Pittston Cemetery, has been purchased by W. S. Tompkins, who is reported about to build a bridge to the island and make a pleasure resort of it.

BALTIMORE, MD.—Resolutions have been presented appropriating $33,000 for a new steel bridge over Gwynn's Falls on Wilkens Ave., and $10,000 for a steel foot-bridge over the B. & O. tracks at the foot of Fulton Ave.

ATLANTA, GA.—It is expected that bids will be asked within a few days for the construction of the proposed Broad St. bridge.

FLORENCE, ALA.—It is stated that the new bridge between this city and Sheffield will be built by the Louisville & Nashville R. R. Co., and will probably cost several hundred thousand dollars.

TUSCALOOSA, ALA.—The contract for constructing

the drawbridge over the Warrior River at this place has been awarded to J. H. Whitner, of Knoxville, Tenn., at $39,400. The bridge is to be of steel 1,635 ft. in length, and will have four spans. The bidders were as follows: C. E. Hamlin, Chattanooga, Tenn.; W. H. Converse, Chattanooga, Tenn.; W. T. Young, Fort Worth, Tex.; M. S. Hosle, Fort Worth, Tex.; Alex. Searles, Vicksburg, Miss.; H. T. Sinnott, Nashville, Tenn.; M. Cope, Chattanooga, Tenn.; George H. Crofts, Atlanta, Ga.; A. M. Julian, Jasper, Ala.; F. M. Dodson, Jasper, Ala.; William T. Allen, Memphis, Tenn.; B. H Hardaway, Birmingham, Ala.; M. Johnson, Louisville, Ky.; D. S. Brady, Chattanooga, Tenn.; Dave East, Leeds, Ala.; John Rily, Louisville, Ky.; Wm. Storbuck, Birmingham, Ala.; J. H. Whitner, Knoxville, Tenn.; W. Finnell, Tuscaloosa, Ala.; H. F. Keepers, Detroit, Mich.; J. S. Wagner, Milwaukee, Wis.; S. A. Wysong, Canton, O.; John Goode, Louisville, Ky.; I. Green, Tuscaloosa, Ala.; A. Stoneking, Tuscaloosa, Ala.

NEW ORLEANS, LA.—The city engineer has prepared specifications for an iron bridge at Galvez St. and another at Hagan Ave., and it is expected that bids will soon be asked for the construction.

CHATTANOOGA, TENN.—The council has been petitioned to provide funds for a new bridge at East Eighth St.

KNOXVILLE, TENN.—The Knoxville, Cumberland Gap & Louisville R. R. Co. is reported about to erect several bridges on its line. Clarence Carey, 59 Wall St., New York, is receiver.

STEUBENVILLE, O.—It is stated that representatives of an Eastern bridge building firm have secured options on both sides of the river at this place for a bridge to be built this summer.

TOLEDO, O.—The Toledo-Maumee Electric Railway Co. has awarded the contract for a new iron bridge across the Maumee River to the Massillon Bridge Co. at $15,000.

INDIANAPOLIS, IND.—F. E. Fuller, Ch. Clk., Cy. Engr.'s office, writes us that plans and specifications for three plate-girder bridges will be ready for examination and inspection about Feb. 1, as follows: Pratt St. bridge over canal, 66-ft. girder, 24-ft. roadway; Raymond St. bridge over Pleasant River, 79-ft. girder, 30-ft. roadway; Spruce St. bridge over Pleasant River, 79-ft. girder, 30-ft. roadway. Contracts will probably be let in about two weeks Chas. C. Brown, Cy. Engr.

DETROIT, MICH.—Preliminary drawings have been submitted to the board of public works for 7 or 8 arches for the 600 ft. of approach to the Belle Isle bridge.

SAGINAW, MICH.—A resolution has been introduced in the council providing for the construction of a bridge at Court St. to cost $65,000.

MENASHA, WIS.—Efforts are being made to secure a new bridge across the Little Lake Butte des Morts.

WINONA, MINN.—A press report states that the Green Bay, Winona & St. Paul R. R. Co. is about to build a railway bridge across the Fox River in Wisconsin for its own use.

JUNCTION CITY, KAN.—A bill has been introduced to authorize the commissioners of Geary county to build a bridge.

BUTTE, MONT.—Bids are asked until Feb. 12 for the construction of a highway bridge 200 ft. long and 16 ft. wide across the Big Hole River at Upper Chalk Bluffs, about 36 miles west of Divide station. David J. Charles, Bd. County Comrs.

GREAT FALLS, MONT.—Local papers state that the Great Northern Ry. Co. will build a bridge across the river at Rainbow Falls and make that its main line to this city.

GEORGETOWN, TEX.—James Belleger, of Austin, has been awarded the contract for the stone piers and bridge abutments on the Trinity, Cameron & Western R. R., now being built between this city and Granger.

DENVER, COLO.—A new steel bridge will soon be built across Cherry Creek at Broadway, at an estimated cost of $45,000. W. F. Hynes, Secy. Bd. Pub. Wks.

TORONTO, ONT.—The council is considering the construction of a high-level bridge over the Don River on Queen St. and a footbridge north of Gerhard St.

BUILDINGS.

FALL RIVER, MASS.—The council has voted to issue $150,000 in bonds for a public library building.

BROOKLYN, N. Y.—Bonds for $295,000 will probably soon be issued for the erection of the first section of the museum of arts and sciences in Institute Park, Prospect Hill. The section will be 210 ft. in length, with an average depth of 50 ft. Estimates have been secured from Norcross Bros. Archs., McKim, Mead & White, New York.

BROOKLYN, N. Y.—The Brooklyn Wharf & Warehouse Co. was incorporated Jan. 21 to practically control all the storage warehouses, docking facilities and elevators in Brooklyn. The company has a capital stock of $12,500,000 and will issue $17,000,000 in bonds. The company intends to make a private railway connecting the entire property. The tracks are to be laid upon the large wharves, so that the cars brought on floats can be run to the ships' sides, or grain in one structure can be sent to a ship lying a mile away without the least difficulty. It is probable that this is the same project noted in our issue of Jan. 10. Pres., Thos. A. McIntyre, of McIntyre & Wardwell; Vice-Presidents, David Dows, Jr., of Dows & Columbia Stores, and J. S. T. Stranahan, Pres. Atlantic Dock Co.; directors, Andrew Mills, New York; Geo. H. Southard, Brooklyn; Geo. W. Young, Jersey City; Theo. A. Havermeyer, of the American Sugar Refining Co.; William Coverly, of the American Steamship Co.

BUFFALO, N. Y.—Bethune, Bethune & Fuchs, Archs., have prepared plans for a theatre to be built for Fuchs Bros., on the east side of Washington St., south of Genesee St., to cost about $150,000. It will be occupied by Michael Shea. The contract for building has not yet been let.

BUFFALO, N. Y.—The Guaranty Building Co. has been incorporated with a capital stock of $500,000 to erect a 13-story building on Pearl and Church Sts.; incorporators, Col. Geo. M. Moulton, of Chicago, Ill.; Willet E. Hazard and Chas. H. Keep, of Buffalo.

NEW YORK, N. Y.—Boehm & Coon have been granted a permit to erect an eight-story brick store at Broadway and Howard St., to cost $350,000.——Armintha Merritt, 339 Boulevard, has been granted a permit to erect a seven-story brick apartment house at Boulevard and 81st St., to cost $300,000.

WEST POINT, N. Y.—It is stated that the construction of the Cullom Memorial Hall will soon be commenced. Col. O. H. Ernst, Supt. Trustees

JERSEY CITY, N. J.—Bids are asked until Feb. 7 for the erection of an annex to the almshouse at Snake Hill. John Boyd, Clk. Bd. of Freeholders; Arch., H. Kreiter, 55 Montgomery St.

WASHINGTON, D. C.—Bids are asked until Feb. 19 for erecting a fireproof addition, except the steel frame, to the government printing house. Col. John M. Wilson, U. S. A.

ANTIGO, WIS.—T. Hayssen, Cy. Clk., writes us that the city hall committee has been directed to secure plans and estimates for a city hall and engine house combined, on a piece of ground 80 × 220 ft., and report Feb. 11; population, 6,000.

CHICAGO, ILL.—It is stated that Henry Ives Cobb has completed the plans and is receiving bids for the construction of the Haskell Oriental Museum at the Chicago University. It will be 40 × 170 ft. and three stories high, and will cost about $100,000.

MASON CITY, IA.—It is reported that Cerro Gordo county is considering a proposition to erect a new court house, at an estimated cost of $100,000.

WATERLOO, IA.—The supervisors of Blackhawk county have called an election in March to vote on the question of building a new court house estimated to cost about $100,000.

ST. LOUIS, MO.—Samuel Cupples is having plans prepared by Eames & Young, Archs., for a warehouse and office building on Spruce St., east and west of Ninth St., estimated to cost $750,000. The structure will be in two buildings, one on each side of Ninth St., and a bridge will be built across the street to connect the buildings.

BEAUMONT, TEX.—Bids are asked until Feb 26 for building a county jail. The iron and steel work may be bid on separately Ed. P. Gray, County Judge; Arch., Eugene T. Heiner, Houston.

WACO, TEX.—It is reported that the citizens will rebuild the Cotton Palace, which was destroyed by fire Jan. 19, at a cost of $100,000.

SAN FRANCISCO, CAL.—Bids are asked until Feb. 11 for building the union depot and ferry house, to be located on the foundation of approach to ferry slips Nos. 2, 3, 4, 5 and 6, on the water front. The work will consist of the necessary structural steel, wrought and cast iron work and other iron work embodied in the specifications, mason work, terra cotta, and fireproofing, plastering, roofing, skylights and galvanized iron work, carpenter and joiners' work, and glazing, painting and plumbing and gasfitting. Ch. Engr., Howard C. Holmes; J. J. Keegan, Secy. Bd. State Harbor Comrs.; Arch., A. Page Brown.

WATER-WORKS.

MACHIAS, ME.—J. K. Ames, E. P. Curtis and others have petitioned for a charter for the Machias Water Co., with a capital stock of $100,000.

WINTERPORT, ME.—T. W. Vose, Fred Atwood, S. N. Morgan, and others have petitioned for a charter for the Winterport Water Co.

WISCASSET. ME.—Henry Ingalls, W. G. Hubbard, Alfred H. Lennox and others have petitioned for a charter for the Wiscasset Water Co., with a capital stock of $100,000.

CHESTER, N. H.—The Chester Water-Works Co. has petitioned for a charter.

LITTLETOWN, N. H.—This village has petitioned for authority to put in water-works and an electric light plant.

PLYMOUTH, N. H.—The question of purchasing the property of the Plymouth Aqueduct & Water Co. for $38,000 is to be voted on at the March election.

SUMMERSWORTH, N. H.—The Great Falls Mfg. Co. has offered to sell its interest in the works for $60,000, and it is reported probable that the city will purchase it. The city already has an interest in the works and it is stated that a pumping station and extensions estimated to cost $125,000 will be added.

EDGARTOWN, MASS.—About 150 persons have signed a petition to the legislature requesting that a charter be granted to the Edgartown Water Co.; capital stock, $50,000; incorporators, Jos. K. Nye, New Bedford; E. D. Eldridge, Fairhaven; H. C. Chadwick, Edgartown.

LONGMEADOW, MASS.—Wm. B. Medlicott writes us that the works are nearly completed.

NORTON, MASS.—J. A. Leonard, Town Clk., writes us that nothing has yet been done for works, but that the question will probably be discussed at the town meeting in March.

RUTLAND, MASS.—Geo. A. Putnam, Town Clk., writes us that D. M. Wheeler, Engr., is one of the committee and will see to all surveys and plans for the proposed works.

FARMINGTON, CONN.—The Farmington Water Co. has petitioned for a charter.

NORFOLK, CONN.—A press report states that Babcock & Lary have taken the contract to finish the partially constructed works.

RIDGEFIELD, CONN.—The contract for constructing works has been awarded to the Connecticut Pipe Co. of New Haven, at $47,224.

WILLIMANTIC, CONN.—Bids are asked until Feb. 15 for a 2,000,000-gallon steam pump, with boilers, as stated in our advertising columns. Walter D. Brigham, Chn. Com.

CAPE VINCENT, N. Y.—The village authorities are reported about to put in works.

FREDONIA, N. Y.—The consulting engineer has indorsed the plan of Mr. Wilder, of this place, for a new supply. Another dam or reservoir is recommended.

NEW YORK, N. Y.—Contracts will probably be awarded in about a month for the construction of the Jerome Park reservoir, estimated to cost $4,000,000.——The park commissioners have reported that $10,000 more is needed for an additional 500,000-gallon pump at the Castle Garden aquarium.

ONEIDA, N. Y.—The question of purchasing the plant of the Warner Water-Works Co. is being agitated.

RED HOOK, N. Y.—The village clerk writes us that the residents have voted to put in works to cost $30,000. It will be a gravity system with eight miles of piping, and about 40 hydrants; supply from a lake 4½ miles distant. Contracts will be awarded in about a month. Engr., E. D. Smalley, Syracuse. D. W. Wilbur, Chn. Com.

SALAMANCA, N. Y.—It is stated that the question of purchasing the works will be voted upon at the next election.

SOUTHAMPTON, N. Y.—The village trustees have contracted for 50 hydrants at $25 each for the first year, $33 for four years, and then $25 each for 20 years.

SOUTHOLD, N. Y.—The Greenport Water Co. has been petitioned to extend its mains to this place, and the cost of the extension is being estimated.

MEDFORD, N. J.—A committee has been appointed to investigate the question of fire protection.

BELLEVUE, PA.—The council is considering the question of granting a franchise.

HAZLETON, PA.—The plans for the new works are reported as completed.

MEADVILLE, PA.—J. F. Witmer, of Voorhees & Witmer, Buffalo, N. Y., has been engaged to estimate the value of the present plant.

MIFFLINBURG, PA.—A petition is being circulated asking that the question of works be voted upon next month

MINERSVILLE, PA.—Chas. R. Kear, Man. Minersville Water Co., writes us that the proposed reservoir and extensions will be made by the company, and that all arrangements have been made.

OIL CITY, PA.—Bids are asked until Feb. 19 for a 5,000,000-gallon pumping engine. A. M. Breckinridge, Clk. Comrs.

SOUTH BETHLEHEM, PA.—It is stated that the next council will be urged to employ an engineer to make surveys for a water supply about 1½ miles east of this place.

WEISSPORT, PA.—The Weissport Water Co. is extending its mains to East Weissport.

WEST NEWTON, PA.—The question of works is being discussed.

WILKES BARRE, PA.—D. O. McCollum, Secy. Citizens' Water Co., writes us in regard to the proposed works noted in our issue of Jan. 17 that the company is awaiting the action of the city council; estimated cost of the plant is $500,000.

SALEM, W. VA.—The town is reported to have voted to issue bonds for works.

MOUNT PLEASANT, N. C.—It is stated that artesian wells will be bored to secure a supply.

GRIFFIN, GA.—The committee is securing a site for the proposed water tower.

TROY, ALA.—Bids are asked for 100 tons of cast iron water pipe, according to reports. L. E. Gellerstedt, Chn. Com.

GREENVILLE, MISS.—The City Water Co. has been incorporated with a capital stock of $50,000, by Nisbet Wingfield, John R. Ellis and others.

NEW ORLEANS, LA.—L. H. Gardner, Supt. New Orleans Water-Works Co., writes us that the contract for 20,000 ft. of extensions, for which bids were received Jan. 21, has been awarded to the Abbott-Gamble Contracting Co., St. Louis, Mo., the bids being as follows:

Railway Supply Co., New Orleans	$20,414
Manion & Co., New Orleans	18,243
Delaney & Foley, New Orleans	15,155
Abbott-Gamble Contracting Co., St. Louis	14,553
Robert McNamara, New Orleans	21,643
Brennan & Co., Baltimore	24,751
Hankin, Mosley & Co., Richmond	20,467
Morrill & Co., New Albany, Ind.	14,745
Fairbanks, Moore & Co., St. Paul,	15,476
C. & T. Iglehart, Morgan Park	15,850

SHELBYVILLE, TENN.—W. W. Cunningham represents a company that is reported about to put in works and an electric light plant.

CARROLLTON, KY.—We are informed that the contract for works has been awarded to Guild & White, of Chattanooga, Tenn., at $19,750. G. W. Pearsall, of Harriman, Tenn., has been retained as consulting engineer.

GREENVILLE, KY.—It is stated that works will soon be put in at this place.

HOPKINSVILLE, KY.—H. W. Tibbs, Cy. Clk., writes us that a 20-year franchise has been sold to Jesse W. Starr, of New York, who will put in works

BEREA, O.—A. F. Goette, Cy. Clk., writes us that the water-works proposition was defeated.

CAMBRIDGE, O.—The council has appropriated $500 to secure plans and specifications for water-works and sewers.

LEBANON, O.—At the election Jan. 22, the citizens voted in favor of works to cost $50,000. The city will sell $2,000 of bonds and if a desirable water supply is found the remaining $48,000 will be negotiated. Engr., John W. Hill, Cincinnati.

LOWELLVILLE, O.—An election will soon be held to vote on the construction of works to cost about $20,000 and an electric light plant to cost $8,000. Wm. L. Erskine, Clk.

TOLEDO, O.—Bids are asked until Feb. 4 for boring two artesian wells. L. P. Harris, Cy. Clk.

EVANSVILLE, IND.—The secretary of the water board has been directed to write for bids for 16 and 6-in. pipe; also for a carload of wrought iron.

OAKLAND CITY, IND.—The local press is agitating the question of works.

PARIS, IND.—It is stated that works, including a stand-pipe, will soon be put in, at a cost of $6,500.

DECATUR, MICH.—Frank C. Stapleton, Cy. Clk., writes us that the following bids were received for constructing works, the city to furnish brick and stone:

*J. W. Pearl, Benton Harbor, Mich.	$11,000
A. F. Nims, Elkhart, Ind.	13,052
C. & T. Iglehart, Morgan Hart, Ill.	12,800
Samuel I. Pope Co., Chicago, Ill.	13,542
T. C. Brooks, Jackson, Mich.	11,995
Mann & Andrews, Dowagiac, Mich.	12,220
John Synom & Co., Chicago, Ill.	13,900

*Awarded contract.

SOUTH BEND, IND.—Efforts are being made by

the citizens to secure important extensions of the works.

CROSWELL, MICH.—It is stated that works will be constructed in the spring. A well is being sunk.

FLUSHING, MICH.—G. F. Herriman, Can. Com., writes us that it is expected to vote bonds March 1.

OXFORD, MICH.—Bids are asked until Feb. 11 for the purchase of $19,000 in 5% water bonds, and $6,000 in electric light bonds. Robert Marshall Village Clk.

SHELBY, MICH.—Geo. C. Morgan, Consult. Engr., Chicago, writes us that the following contracts were awarded for materials, as advertised in Engineering News: Cast iron pipe and specials to the Anniston Pipe & Foundry Co., Anniston, Ala.; wrought iron pipe and fittings to Geo. H. McDermid, Grand Rapids, Mich.; hydrants to Crane Co., Chicago, Ill.; valves to the Rensselaer Mfg. Co., Troy, N. Y.; pumping machinery to Downie Pump Co., Valencia, Pa.; boiler to Muskegon Boiler Wks., Muskegon, Mich.; heater to Stilwell-Bierce & Smith-Vaile Co., Chicago; other materials purchased from home bidders, who will also do the work.

BELLEVILLE, ILL.—It is reported that plans have been made for improvements to cost $25,000.

CANTON, ILL.—Improvements projected for this year include the sinking of an artesian well and increasing the pumping capacity. No definite action has been taken. Cy. Engr., G. W. Chandler.

CARBONDALE, ILL.—The Carbondale Water Co. has secured the contract to furnish the city with water; the city to rent 30 hydrants for 21 years at an annual rental of $50 each. An abundance of pure, soft water can be obtained at a depth of 350 ft. The company will issue bonds. J. R. Truesdale, Temple Bldg., St. Louis, may be addressed.

CERRO GORDO, ILL.—E. E. Edwards writes us that the proposed works will include a brick tower with a wooden tank, which will hold 65,000 gallons, and a small reservoir; contracts have not yet been let; the supply will be from wells, and information is solicited from parties that sink wells.

CHICAGO, ILL.—Bids are asked until Feb. 6 for furnishing and delivering at the North Branch of the Chicago River, near Western Ave., one air lock and two iron shells with shoes for tunnel shaft. John McCarthy, Comr. Pub. Wks.

MARSEILLES, ILL.—It is stated that a franchise has been granted for works to cost $100,000.

MARSHALL, ILL.—T. W. Clark, Mayor, writes us that the proposition for works has been voted down three times within 12 months, and that there is no present prospect of securing works.

MILAN, ILL.—Geo. W. Smith, Vil. Clk., writes us that the following bids were received Jan. 21 for constructing works:

Casgrain & McDonald, Chicago, (awd. contract)..$9,256
Challenge Wind Mill & Fd. M. Co., Batavia, Ill. 9,721
Crellin & Lovell, Des Moines, Ia.....10,779

MOUNT PULASKI, ILL.—H. B. Capps, Cy. Clk., writes us that plans and specifications for complete works are being prepared by D. H. Maury, of Peoria, and will be ready about Feb. 15; the work will cost about $25,000, but only $9,000 will be spent at present; test wells are now being sunk; water will be pumped from wells to a 60,000-gallon tank on a tower 60 ft. high.

OAKLAND, ILL.—It is stated that works could be put in for $5,000; the question is being agitated.

TOLONO, ILL.—The contract for works is reported to have been awarded to a Chicago firm.

GALESVILLE, WIS.—The city clerk writes us that no works will be put in at present.

KAUKAUNA, WIS.—The city is considering a proposition of Mr. Fritchman, of New York, to put in works, according to press reports. The franchise granted to J. L. Hotchkiss last summer has been annulled because of failure to begin work.

KENOSHA, WIS.—W. H. Wheeler & Co., who are putting in the new works, are reported as negotiating for the purchase of the Kenosha Water Co.'s plant, with a view to selling the entire system to the city.

MONROE, WIS.—A contract for drilling three new wells has been awarded to F. M. Gray, Milwaukee.

TWO RIVERS, WIS.—Wm. Hurst, Cy. Clk., writes us that no definite action has yet been taken to extend the works, but that after the spring election some extensions will probably be made. W. S. Shields, of Chicago, is making plans.

FORT MADISON, IA.—The Fort Madison Water Co. was incorporated in New Jersey Jan. 23, with a capital stock of $275,000; incorporators, A. G. Brown, Lewis Hallock, Jr.; Robt. H. Dillingham and H. F. Hatch, of East Orange, N. J., and Chas. N. Brown, of Jersey City, N. J. The sale of the works to Alexander New, representing the bondholders, was noted in our issue of Jan. 10.

INDIANOLA, IA.—Plans for complete works are being prepared by C. S. McClanahan, Monmouth, Ill.

BENSON, MINN.—The village recorder writes us that no works are contemplated at this place.

PLAINVIEW, MINN.—R. R. Damonds, Recdr., writes us that the proposed works will include a tower 80 ft. high, a 65-000-gallon tank, three miles of mains and 35 hydrants, the supply to be from a well 320 or more feet deep. The question of construction will be voted upon about Feb. 15.

DE SMET, S. DAK.—Bids are asked until Feb. 2 for drilling an artesian well from the depth of 1,600 ft. to the depth of 1,650 to 1,700 ft., well to be 6 ins. in diameter when completed. J. H. Armstrong, Chn. Com.

TOPEKA, KAN.—The city engineer is preparing plans for new works to be owned by the city. The plans will include a stand-pipe and a supply from the river just below the old pumping station at Harrison St.

MONROE CITY, MO.—It is stated that $10,000 will be paid to a company that will put in works.

SPRINGDALE, ARK.—E. H. Bryant, Cy. Recdr., writes us that no steps have yet been taken for works, but that such steps should be taken, and if the subject is properly agitated probably will be; population, 1,600.

AUSTIN, TEX.—The superintendent has recommended the laying of 37,000 ft. of 6-in. and about 150,000 ft. of smaller pipe.

DALLAS, TEX.—Bids are asked until Feb. 19 for the construction of 15,000 ft. of 36-in. wooden stave pipe line, as stated in our advertising columns. The bids received for 15,000 ft. of 30-in. cast iron pipe were published in our issue of Jan. 3. R. W. Havens, Cy. Engr.

HILLSBORO, TEX.—Geo. R. Terrell, Cy. Secy., writes us that the bonds are in the hands of the printers and that nothing will be done until about April 1; estimated cost, $20,000; supply from artesian well. Engr., D. A. Poynor, Dallas.

LORENA, TEX.—The citizens have contracted with J. B. Fowler, of Waco, to sink an artesian well.

WEIMAR, TEX.—The mayor writes us that the question of works will be voted upon April 2, and that nothing has yet been done in the matter; population, 1,600.

ASTORIA, ORE.—The total bids received for constructing works were noted last week. Contracts have been awarded as follows: Pacific Paving Co., of Portland, clearing the right of way, grading road, constructing bridges, culverts, and telephone line, excavating and refilling trenches on the conduits, and excavating reservoir, $19,740; diverting the weir and settling basin, $1,743; lining of reservoir, erection of gate and powerhouse, and all appliances therefor, $16,207; tunnel, $4,996. Excelsior Wood Co., furnishing and laying wooden stave conduit, $31,368. Paquet & Kibner, furnishing and laying steel conduit, $29,558. Pacific Bridge Co., distributing system, $44,203. The aggregate amount of the bids accepted is $147,915, or $2,260 less than the lowest bid, that of the Pacific Paving Co. The bonds were sold to Rudolph Kleybolt & Co., of Cincinnati, at 95 and accrued interest. H. G. Van Dusen, Clk. Comrs.

ATHENA, ORE.—E. W. Cummings, of Portland, and Chas. Power, of Seattle, have submitted a proposition to put in works. It is proposed to dig four wells 10 ft. square and 20 ft. deep and lay 8 and 6-in. mains with 3-in. service pipes; payment to be taken in $12,000 of city bonds.

SAN DIEGO, CAL.—The Mountain Stream Water Co. has been incorporated with a capital stock of $10,000,000, commencing with $2,000,000; incorporators, J. M. Howells, Chicago; John D. Works, Lewis R. Works and R. A. Thomas, San Diego, and W. W. Thomas, Los Angeles, Cal.

CLOVERDALE, CAL.—The Riverside Water Co. is reported as considering plans for securing a gravity supply from Sulphur Creek.

LUNENBURG, N. S.—C. L. Goodhue, Chn. Water Comrs., Springfield, Mass., has contracted to build works for this town and is now receiving bids for pipes, gates and hydrants, which will be purchased in this country.

IRRIGATION.

UVALDE, TEX.—Press reports state that Col. M. P. Merwin, one of the parties interested in the Uvalde Irrigation Mfg. & Water Supply Co., has said that the machinery and engineers for the construction of the canal from the Nueces will arrive soon, when work will begin at once upon the construction.

ANAHEIM, CAL.—The Anaheim Union Water Co. is reported to have voted to replace the old wooden flumes at Yorba cemetery with three steel ones, estimated to cost $19,200.

NEW COMPANIES.—San Antonio Irrigation Co., San Antonio, Tex.; $100,000; Zo Stocker, J. S. Taylor, J. O. Nicholson.

Chickamauga Canal Co., Crowley, La., to build a canal for irrigation purposes; A. R. McMurdy & Co., Marshall, Ind.; Bence & Arnold, Greencastle, Ind.; John B. Wright.

Water Supply, Irrigation & Pumping Co., Kansas City, Kan.; $1,000; W. S. Nelson, H. A. Young, Kansas City, Mo.; W. O. Huckett, T. S. Coles, S. J. Green, Kansas City, Kan.

Cooke Ditch & Reservoir Co., Greeley, Colo.; $10,000; to build an irrigation ditch out of Lone Tree Creek, and to control the Cooke reservoir in Weld county; J. B. Cooke, Noah Miller, E. M. Cooke.

Cimmarron Valley Irrigation Co., Topeka, Kan., and Kansas City, Mo.; $200,000; William Robert, Hamilton, O.; F. T. Hughes, Keokuk, Ia.; W. F. Evans, Topeka, Kan.; A. L. Forsha, Hutchinson, S. W. Winn, Kansas City, Mo.; D. S. Fletcher, Hartford, Conn.

SEWERAGE.

ATTLEBORO, MASS.—The question of constructing a $200,000 system will be discussed at the town meeting in March. F. C. Coffin, of Boston, and W. J. Luther, of this city, are preparing the plans.

BOSTON, MASS.—Press reports state that Mayor Curtis has signed the loan bill of $67,650 for the completion of the system at Dorchester. The work is being done by day labor.

BOSTON, MASS.—A pumping station, 72 × 120 ft., for the metropolitan system is to be erected on Alford St., near Malden Bridge, Charlestown, at a cost of about $125,000. Arch., A. F. Gray.

BROCKTON, MASS.—A contract for sewer pipe has been awarded to Waldo Bros., of Boston, at $22,593. It is stated that the price last year for the same amount of pipe was $28,777.

CONCORD, MASS.—The town has petitioned for authority to construct a system of sewers.

MILTON, MASS.—The selectmen have petitioned for authority to construct a system of sewers.

WOONSOCKET, R. I.—Councilman McLaughlin is quoted as stating that the city appropriated $50,000 for sewers six months ago to give work to the unemployed and that nothing has yet been done about it.

ROCKVILLE, CONN.—The aldermen have voted to authorize a special committee to employ engineers and award contracts for constructing a system. S. M. Gray, of Providence, was in the city last week, and reported that it would probably take four months to finish plans, so that bids could be asked for the construction, and it is probable that most of the system will not be built till 1896.

SOUTHINGTON, CONN.—The engineer has submitted the following estimates for a system: 17,500 ft. of main sewer, at $1.75, $30,625; 40 manholes, at $40, $1,600; 25 acres of land, at $20, $500; right of way through private property, $500; grading six acres of land for filter beds, $3,500; eight distributing wells and distributing sewers at filter beds, $1,500; engineering, etc., $2,500; lateral sewers, $39,410; total, $80,135. The question will probably be submitted to a vote of the taxpayers next month. E. G. Lewis, Cy. Clk.

AUBURN, N. Y.—J. F. Witmer, of Buffalo, and W. H. Chapman, of New York, have inspected the plans for the Ninth Ward system. A system is said to be badly needed in that section of the city.

BATAVIA, N. Y.—J. W. Holmes has reported that a system would cost $252,000; Mr. Holmes has been at work on the surveys and plans for over a year. The report will be submitted to the state board of health for approval.

BROOKLYN, N. Y.—Contracts for constructing sewers in Ward 26 have been awarded to the lowest bidders, as follows; the prices of some of the bids were published last week: Edward Gorman, subdivisions 2, 4 and 6, $38,196, $35,174 and $6,383, respectively, all for cement pipe; J. C. McSpadden, of Pittsburg, for subdivision 18, $13,069, vitrified pipe; D. J. Creem, for subdivision 21, $20,801, vitrified and cement.

BUFFALO, N. Y.—The following bids were received Jan. 24, for the construction of a sewer in Kensington Ave., from the sewer in Wyoming Ave. to a point 880 ft. west of Grider St.: Jacob Ritzmann, $9,768; William Franklin, $10,800; August Gisel, $8,999; Fred J. Martin, $10,302; Elmer Mighton, $8,778; Geo. W. Moore, $8,787; W. A. Rappich, $9,301; Henry Harter, $11,421; John Harrer, $8,000; Christopher Smith, $8,500; John Mumm, $8,998; Thos. B. Reading, $11,233.

BUFFALO, N. Y.—The following bids were received Jan. 22 for a sewer in South Ogden St., all the bidders being residents of this city: William Franklin, $11,800; Elmer Mighton, $9,565; A. R. Clark & Co., $13,573; C. Smith, $11,420; George W. Moore, $11,004.99; Jacob Ritzmann, $11,833; Henry Harter, $11,556; Thomas B. Reading, $12,600; Fred J. Martin, $12,182; W. A. Rappich, $14,261; Henry Kebbin, $12,310; John Mumm, $12,260; W. G. Smith, $10,761.

NEW YORK, N. Y.—Bids are asked by the department of public works until Feb. 5 for completing a sewer in 96th St., between 1st Ave and the Harlem River.

SEA CLIFF, N. Y.—The Sea Cliff Improvement Association has appointed a committee, consisting of Edwin H. Speed, John Graham, of the association, and C. S. Chellborg and L. H. Willis of the village trustees, to consider plans for a system.

TONAWANDA, N. Y.—The commissioners are considering the plans of W. B. Landreth, of Cortland, for sewers in Gastown. The plans have been approved by the state board of health, and the taxpayers will vote on the questionabout Feb. 15. The plans provides for pumping the sewage from five miles of stretts, by two Shone ejectors, using steam from the water-works boilers for the air compressor, and the estimated cost is $35,000, for the separate sewers, the ejectors, air pipe, compressor and a little over a mile of combined sewers on Delaware Ave.

HOBOKEN, N. J.—An ordinance has been passed for a brick outlet sewer on a pile foundation for draining the lowlands. M. V. McDermott, Cy. Clk.

PATERSON, N. J.—Ordinances have been passed for constructing sewers in several streets.

SEA ISLE CITY, N. J.—The Sea Isle City Electric Light, Water & Power Co., noted last week as having been granted a franchise for water-works, has been granted a franchise to put in a sewerage system in connection with the water-works. The improvements will be made within a year and will probably cost $150,000.

ALLEGHENY, PA.—At an election Feb. 19 the question of issuing $200,000 in bonds for sewer improvements will be voted on.

NORRISTOWN, PA.—Plans for a separate sewerage system have been prepared by M. D. Patterson, Borough Engr. About 13 miles of sewers will be required for the built-up portion of the borough; although the surveys cover 46 miles of streets.

READING, PA.—The city engineer and sewer committee have agreed to recommend that the sewage disposal plant be located on Fritz's Island, in the Schuylkill River, several miles below the city.

SCRANTON, PA.—An ordinance is being considered for the construction of sewers in the south part of the city to cost about $36,000.

ROANOKE, VA.—A contract for a brick wall in Lick Run drain has been awarded to A. J. Banks at $2,139; the other bidders being S. B. Markley, $2,260; L. H. Vaughan & Co., $2,320; W. P. Hyman & Co., $3,344; C. E. Watson, $2,997; R. S. Coffman, $2,880; N. P. Foard, $2,892; E. T. Lauding, $2,334.

CAMBRIDGE, O.—The council has appropriated $500 for the employment of an engineer to secure plans and specifications for sewers and water-works.

CLEVELAND, O.—Bids will soon be asked for constructing a large number of sewers, estimated to cost $346,100. F. C. Williams is the engineer in charge of sewers and drains.

COLUMBUS, O.—Bids are asked until Feb. 5 for constructing a 15 and 12-in. pipe sewer in one street. J. A. Fanning, Clk. Bd. Pub. Wks.

HAMILTON, O.—It is reported that the bids for the force mains and connections with the sewage pumping station will be rejected and the work readvertised.

YOUNGSTOWN, O.—The council has voted to construct a sewer in Orange St., from Glenwood Ave. to Edwards St. J. H. Edwards, Cy. Clk.

GRAND RAPIDS, MICH.—H. A. Coller, Cy. Surv., is preparing plans for sewers in Wards 11 and 12.

BLOOMINGTON, ILL.—An ordinance has been signed by the mayor for constructing sewers in Washington and Morris Ave. R. N. Evans, Cy. Clk.

CANTON, ILL.—About one mile of extensions will probably be made this year. D. W. Chandler, Cy. Engr.

PEKIN, ILL.—Plans for a complete system will probably be completed in about a month. Consult. Engrs., Harman & Evans, Peoria; Cy. Engr., J. C. Aydelott.

WAUKEGAN, WIS.—Large & Philbin have prepared plans for 2,170 ft. of 18-in. pipe sewer in Spring St., estimated to cost $3,250.

SIOUX FALLS, S. DAK.—The council is considering the construction of a system.

ST. JOSEPH, MO.—The council has voted to construct sewers in a portion of district No. 43. T. P. Wright, Cy. Clk.

DENVER, COLO.—It is expected that 42,000 ft. of 8-in. sewer will be constructed in the spring at an estimated cost of $45,000. W. F. Hynes, Secy. Bd. Pub. Wks.

MARYSVILLE, CAL.—Geo. A. Atherton, Cy. Surv. of Stockton, has been engaged to advise the council in regard to a system of sewerage and drainage for the city.

SAN FRANCISCO, CAL.—Property owners have petitioned that the 15th St. sewer be immediately reconstructed and changed to a 5-ft. circular brick sewer.

GARBAGE DISPOSAL.

NEW HAVEN, CONN.—The successful bidders for collecting garbage for the ensuing year were: A. N. Farnhan, at $3,140 for the west side of the city, and Andrew Halloran, at $1,000, for the east side.

BUFFALO, N. Y.—The committee has recommended that the contract for collecting garbage and ashes and disposing of the same be awarded to John Johnson, at $110,141. Cooper & Hopkins, of Chicago, bid $141,076; Williams, McNaughton & Bapst, $138,875, and Brown & Stabell, $136,475. The council is reported as in favor of having the work done by the city.

PITTSBURG, PA.—The new garbage regulations will be put into effect as soon as the necessary money is provided, and it is stated that bids will then be asked. The contractor will have to build five garbage furnaces in different parts of the city, according to reports.

ATLANTA, GA.—The "Constitution" states that two or three more crematories are needed in the city.

ST. PAUL, MINN.—Bids are asked until Feb. 5 for collecting and disposing of the garbage of the city from March 1 to Dec. 31. Thos. A. Prendergast, Cy. Clk.

STREETS AND ROADS.

LOWELL, MASS.—The Middlesex county commissioners have decided to proceed with the construction of a new highway on the east side of the Merrimack River from this city to Tyngsboro. It is understood that the state highway commission will macadamize paving and macadamizing. J. A. Fanning, Clk. Bd. Pub. Wks.

LORAIN, O.—A correspondent writes us that Broadway St., 7,000 ft. long., will be paved this spring. The work will require 42,000 sq. yds. of paving. L. A. Fauver is city engineer.

MARION, O.—The city will soon advertise for bids for paving two streets with brick. T. C. Bowen, Cy. Engr.

SANDUSKY, O.—We are informed that bids for paving Water St. will not be received Feb. 1, as recently stated, but that the work will soon be advertised.

BEDFORD, IND.—At a special election Jan. 22 the citizens voted to construct 25 miles of macadam and gravel roads leading from the city to the different townships.

INDIANAPOLIS, IND.—The contract for paving Washington St. from Michigan Road to State St. has been awarded to the Indiana Bermudez Asphalt Co., at $5.60 per lin. ft.

INDIANAPOLIS, IND.—Bids are asked by the board of public works until Feb. 6 for paving South Pennsylvania St. from Maryland to South St., with brick on concrete. The approximate quantities are: length, 1,360 ft.; width, 60 ft.; area, 9,329 sq. yds.; 5 × 24-in. curb, 2,625 ft.; 6-ft. radius curb, at corners, 75 ft.; marginal stone, 396 ft.; two catch basins; four inlets to catch basins; four inlets to Pogue's Run. Chas. C. Brown is city engineer.

WABASH, IND.—Bids are asked until Feb. 11 for the improvement of Chestnut St., from Vernon St. to Columbus St., by grading, macadamizing and paving the sidewalks. Howe McGuire, Cy. Clk.

LANSING, MICH.—The bids for macadamizing Shiawassee St. have been rejected, and the work will be readvertised.

AURORA, ILL.—The bids for paving Michigan Ave. have been rejected.

CANTON, ILL.—We are informed that about one mile of brick paving will probably be laid this year. G. W. Chandler is city engineer.

CHICAGO, ILL.—The council has passed ordinances for paving portions of 5 streets with brick, 6 with stated in our advertising columns. Woodward Emery, Chn. Comrs.

PLUMBING.—New York, N. Y.—Bids are asked until Feb. 19 for the plumbing for the U. S. court-house and post-office building in this city, as stated in our advertising columns. Address Chas. E. Kemper, Acting Supervising Architect, Washington, D. C.

GAS WELLS.—Batavia, N. Y.—W. W. Cheney, of Buffalo, and A. W. Lewis, of Pittsburg, are reported as securing leases of 25,000 acres of land in the southern part of this town and in Alexander and Darien with a view to sinking test wells for natural gas.

SURVEYS.—Glencoe, Minn.—J. Jay Hankenson, Minneapolis, is making a topographical survey of this village to establish street, sidewalk and drainage grades, the work covering a square mile of territory which is built up and has been graded and drained without regard to engineering principles.

TUNNELS.—Brooklyn, N. Y.—It is stated that the South Brooklyn R. R. & Terminal Co. through its counsel, Jesse Johnson, has secured the right from the city to construct two tunnels, one under the Ocean Parkway, north of Avenue A, and the other under Fort Hamilton Ave., between 38th and 39th Sts.

DREDGING.—Lorain, O.—The village has established the dock lines of Black River at a minimum distance of 400 ft. apart for a distance of four miles up the river from the lighthouse, and this summer a channel 90 ft. wide and 17 ft. deep will be made for this distance, requiring about 300,000 cu. yds. of dredging. L. A. Fauver is city engineer.

RIVER IMPROVEMENT.—Columbus, O.—Bids are asked until Feb. 12 for the improvement of the Miami River, commencing at the bulkhead of the Lewiston reservoir, in Logan county. The state has appropriated $7,000 for the work. Specifications can be obtained from J. C. Wonders, Engr., Bellefontaine, or from Chas. E. Perkins, Ch. Engr. Pub. Wks.

CONTRACT PRICES.

SEWERS.—Charlotte, N. Y.—C. A. Derr writes us that the contract for constructing a sewer system, as advertised in Engineering News, has been awarded to Ryan & Avery, of Watertown, the bids being as follows:

Bids Received for Constructing Sewer System at Charlotte, N. Y.

Quantities.	Ryan & Avery, Watertown, N. Y.	H. M. Dowd & Co., Orange, N. J.	James Holahan, Rochester, N. Y.	Makin & Co., Niagara Falls, N. Y.	Elmer Mighton, Buffalo, N. Y.	B. G. Coon, Kingston, Pa.	E. B. Kay, Bellwood, Pa.	A. F. Nims, Elkhart, Ind.	E. L. & H. T. Oliver, Rochester, N. Y.	De Santis & Co., Niagara Falls, N. Y.	John Marsden, Utica, N. Y.	John Calnan, Rochester, N. Y.	Brayer & Albaugh Rochester, N. Y.	Whitmore, Raubet & Vicenus, Rochester, N. Y.
6-in. pipe, 1,000 ft	$ .26½	$ .29	$ .31	$ .30	$ .32	$ .37	$ .28	$ .35½	$ .35	$ .32	$ .55	$ .45	$ .45	$ .45
8 " " 12,820 "	.31½	.32¼	.36	.38	.34	.39	.35	.46½	.43	.41	.45	.50	.70	.92
10 " " 4,600 "	.35½	.49	.42	.40	.40	.50	.46	.47½	.49	.42	.55	.57	.90	.98
12 " " 2,265 "	.45½	.51½	.47	.55	.49	.58	.71	.57½	.61	.72	.68	.65	1.00	1.38
15 " " 510 "	1.01	.78	.57	.75	1.14	1.19	1.10	.90½	.71	.93	.95	1.47	1.30	2.08
18 " " 2,390 "	.91	.79	.80[2]	1.00	.77[3]	1.03	1.00[4]	.60½[5]	.95	1.57	1.40	.65[6]	1.43[6]	1.89[7]
5 " house cons., 8,000 ft	.19	.25¼	.26	.25	.25	.24¼	.25	.27½	.30	.31	.25	.18	.35	.40
6 " Y-branches, 36	.25	.25	.33	.05	.21	.19	.35	.39	.50	.35	.27	.34	.30	.35
8 " " " 480	.33½	.25	.50	.05	.30¼	.28	.40	.48	1.00	.42	.41	.51	.50	.50
10 " " " 176	.50	.25	.70	.05	.42¾	.41	.55	.61	1.00	.52	.59	.74	.60	.65
12 " " " 80	.60	.25	.90	.05	.55¼	.53	.65	.73	1.00	.75	.77	.96	.75	.85
15 " " " 20	.90	.25	1.40	.05	.80¼	.78	.95	.98	1.15	1.10	1.13	1.41	1.25	1.20
18 " " " 55	1.00	.25	1.50	.05	1.08¼	1.06	1.00[8]	1.27[9]	1.15[10]	1.35[11]	1.53	1.41[12]	1.50	1.55[13]
Manholes, complete, 23	35.00	34.00	35.00	40.00	25.00	30.00	40.00	39.90	48.00	55.00	38.00	41.51	35.00	62.00
Lampholes " 27	8.00	2.50	5.00	5.00	7.65	11.00	12.00	3.60	12.00	2.79	4.00	5.28	8.00	10.00
Flush tanks, " 14	75.00	55.00	45.00	40.00	55.00	36.00	45.00	71.00	75.00	49.00	54.00	78.00	45.00	92.00
18-in. iron pipe, 60 ft	2.00	3.00	3.00	5.00	5.00	1.70	1.60	2.60	3.00	1.25	2.25	2.65	3.00	3.50
Rock, per cu. yd	3.00	5.00	1.00	3.00	8.00	1.65	2.00	4.60	1.25	6.00	2.50	2.50	2.50	2.00
Concrete, per cu. yd	6.00	7.50	4.00	4.00	5.50	4.50	4.50	6.00	5.00	7.50	3.50	5.00	5.00	4.50
Total	$13,755	$14,215	$14,655	$14,994	$15,034	$15,921	$15,991	$17,147	$18,074	$18,429	$18,577	$19,164	$25,169	$31,454

[1] $.80 and $.90. [2] $.77 and $1.35. [3] $1.00 and $1.10. [4] $.60½ and $.97½. [5] $.65 and $1.75. [6] $1.43 and $1.50. [7] $1.89 and $.95. [8] $1.00 and $1.15.
[9] $1.27 and $1.37. [10] $1.15 and $2.00. [11] $1.35 and $1.50. [12] $1.41 and $1.92. [13] $1.55 and $1.60.

the road, and that the county commissioners will lay it out and grade it. The road, if built, will be an extension of Lowell's pleasure drive, known as Pawtucket boulevard.

PROVIDENCE, R. I.—The council is considering a resolution petitioning for authority to issue $600,000 in bonds for highway work.

PUTNAM, CONN.—It is reported that two portions of Elm St. are to be macadamized.

ROCKVILLE, CONN.—It is reported that steps are being taken to pave Market St.

ALBANY, N. Y.—The contract board has recommended additional paving with granite blocks in several streets.

NEW YORK, N. Y.—Bids are asked by the department of public works until Feb. 5 for 6,000 lin. ft. of bridge stone, 15,000 cu. yds. of sand, and for repairing the granite block pavements in several streets; also for grading several streets.

SING SING, N. Y.—A special election will be held Feb. 5 to vote on a tax of $15,000 to construct a new road to the railway station from the southern portion of the village.

SYRACUSE, N. Y.—The Fruin-Bambrick Construction Co. has been organized here to bid on paving in this city. Thos. Merriam is said to be interested.

ALLEGHENY, PA.—At an election Feb. 19 the question of issuing $500,000 in bonds for street improvements, and $300,000 for improvement of rural highways, will be voted upon.

HARRISBURG, PA.—The senate committee on agriculture has voted in favor of a bill for constructing roads. The committee is considering another bill for appropriating $1,000,000 a year for improving roads.

WASHINGTON, D. C.—The Columbia Paving & Supply Co. has been incorporated by S. P. Gross, Wm. H. Lepley and Wm. S. McCarthy, to manufacture and sell artificial stone cement and lime.

ATLANTA, GA.—A petition has been filed for a new road from the river at the end of Chattahoochee Ave., to Pace's Ferry, a distance of about two miles. John T. Cooper, Clk. Comrs.

COLUMBUS, O.—Bids are asked until Feb. 5 for cedar blocks, 5 with other material, and for curbing, grading and macadamizing a large number of streets.

DECATUR, ILL.—The city clerk has been directed to advertise for bids for paving two streets.

EAST ST. LOUIS, ILL.—The estimated cost of reconstructing St. Louis Ave. between 8th and Collingsville Ave. is about $125,000. The street will be raised about 12 ft. on an average, and paved with brick.

GLENCOE, ILL.—Bids are asked until Feb. 5 for grading, macadamizing and otherwise improving Sheridan Road, including a bridge across the ravine. Granville D. Hall, Village Clk.

OSHKOSH, WIS.—Bids are asked by the board of public works until Feb. 11 for grading and filling 8th St. from Michigan to Ohio St.

SPARTA, WIS.—Bids are asked until Feb. 11 for macadamizing 12,000 lin. ft. of street. Address the city clerk.

ST. LOUIS, MO.—The Skrainka Construction Co. has been awarded the contract by Nelson & Mersman for $50,000 worth of improvements in Kingsbury Place. The streets will be laid out and paved with brick, with 10-in. granite curbing.

DENVER, COLO.—The chamber of commerce has passed resolutions petitioning the legislature for the construction of a wagon road across the range to North Park.

DENVER, COLO.—A correspondent writes us that 20,000 sq. yds. of sandstone block paving will probably be laid in the spring, at an estimated cost of $50,000. W. F. Hynes, Secy. Bd. Pub. Wks.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

RIVER WIDENING.—Cleveland, O.—The council has appropriated $25,000 to widen the Cuyahoga River.

DRY DOCK.—Key West, Fla.—Efforts are being made to secure an appropriation of $1,000,000 for the construction of a large dry dock at this place.

DRAINAGE.—Bay City, Mich.—The city engineer has submitted a report to the county supervisors in regard to draining certain low lands in the county.

DREDGING.—Boston, Mass.—Bids are asked until Feb. 19 for dredging 27,500 cu. yds. in East Boston, as

SEWER BASINS.—Brooklyn, N. Y.—The following bids were received Jan. 21 for constructing such sewer basins as may be ordered by the council during 1895:

J. McKeever & Bro.,	for each basin	$96.45
J. W. Van Ostrand, Jr.,	"	93.00
James Jennings,	"	91.50
Norton & Gorman,	"	91.50
John O'Grady,	"	91.00

CAST IRON PIPE.—Cleveland, O.—The lowest bid for a supply of 40 to 3-in. cast iron water pipe was that of the Lake Shore Foundry, at $17.25 per ton at the foundry, or $17.85 delivered on the streets.

PUMPING ENGINES.—Allegheny, Pa.—The subwater committee has voted to award the contract for three 12,000,000-gallon pumping engines to the Groshon High Duty Pumping Engine Co., at $177,000. The bids were published in our issue of Dec. 26. Robt. Swan, Cy. Engr.

RAILWAY TRESTLE.—New York, N. Y.—The following bids were received Jan. 21 for 2,000 ft. of single track railway trestle at Sandy Hook, N. J., the price being per ft.:

Hiram M. Conklin, West Brighton, N. Y.	$7.74
Thos. H. Stanley & Co., New York	7.29
Jos. Jewkes & Sons, Jersey City, N. J.	6.41
P. Sanford Ross, Jersey City, N. J.	5.85
I. H. Hathaway & Co., Philadelphia, Pa.	6.38
Watkins & Hardaway, Richmond, Va.	6.86
John A. Kelley, Brooklyn, N. Y.	7.03
John D Walsh, Brooklyn, N. Y.	7.48
John McLean, New York	5.95
W. B. Wilson, Buffalo, N. Y.	7.68
Wm. L. Miller, Boston, Mass.	6.74
Sanford & Brooks, Baltimore,	9.95
Frank Pidgeon, Saugerties, N. Y.	6.98
Jos. J. Churchyard, Buffalo	7.231
Sanford & Stillham Co., Jersey City, N. J.	7.00

ASPHALT PAVING.—Jersey City, N. J.—Only two bids were received for the improvement of Ogden Ave., from Bowers St. to Congress St., and that of the Vulcanite Paving Co. was rejected as informal. The bid of the Barber Asphalt Paving Co. was as follows: Rock excavation, $1 per cu. yd.; sand or gravel filling,

$1.25 per cu. yd.; asphalt paving, $2.67 per sq. yd.; new curbstone, 55 cts. per lin. ft.; new flagging, 13 cts. per sq. ft.; repaving, 25 cts. per sq. yd.; flagging relaid, 2 cts. per sq. ft.; cribbing, 35 cts. per lin. ft.; new receiving basins, $85 each; receiving basins reset, $10 each; manhole heads brought to grade, $2 each.

BRICK PAVING.—Aurora, Ill.—Bids for paving Lincoln Ave. with one course of brick on a macadam foundation ranged from $1.08 per sq. yd. for Galesburg brick to $1.23 for the same brick. There were nine bidders.

SEWER GRATES, ETC.—Detroit, Mich.—The contract for sewer grates, etc., during 1895 has been awarded to the Co-operative Foundry Co., Detroit, at $1.40 each for round-locking covers, $2.90 for round-locking grates, and 98 cts. per 100 lbs for iron castings.

SEWERS.—Watertown, Wis.—The lowest bids received Jan. 18 for constructing sewers was noted last week under Sewerage. G. O. Viebahn, Cy. Engr., writes us that the itemized bids were as follows:

Bids Received at Watertown, Wis., for Constructing Sewers.

	Vitrified pipe.								
	8-in. 15,381 ft.	10-in. 4,553 ft.	12-in. 2,757 ft.	15-in. 1,435 ft.	18-in. 545 ft.	20-in. 780 ft.	Manholes, 53.	Flush tanks, 18.	Total.
James H. Roche, Chicago	$0.39	$0.48	$0.60	$0.76	$1.03	$1.20	$24.50	$30.00	$14,265
William Gorder, Watertown	.32	.55	.71	.97	1.40	1.70	20.00	25.00	14,374
Geo. R. King & Co., Duluth, Minn.	.39	.47	.49	.75	.95	1.30	33.25	34.50	14,481
C. A. Mosher, Milwaukee,	.42	.48	.52	.77	.85	.97	31.00	27.00	14,533
Green & Patterson, Winona, Miss.	.40	.50	.58	.75	.90	1.35	28.00	30.00	14,672
Jacob Weinner, Milwaukee	.43	.44	.58	.65	1.00	1.50	25.00	30.00	14,729
Geo. J Markey, Milwaukee	.36	.55	.60	.70	1.15	1.65	30.00	30.00	14,744
McCann & McLellan, Ashland, Wis.	.38	.47	.55	.90	1.15	1.45	33.00	30.00	14,843
D. W. Lenehan & Co., Dubuque, Ia.	.40	.50	.60	.85	1.20	2.00	27.00	32.00	15,524
William Forrestal, Milwaukee,	.43	.60	.70	.80	1.00	1.50	25.00	28.00	15,968
C. H. Wells, Appleton, Wis.	.50	.61	.67	.86	1.08	1.25	25.00	28.00	16,942
N. F. Reichert, Racine, Wis.	.50	.67	.77	.92	1.20	1.60	28.00	30.00	18,110
W. M. Campbell, Menominee, Mich.	.50	.57	.65	1.03	1.30	1.90	35.00	35.00	18,231

METAL MARKET PRICES.

LEAD.—New York: 3.12 to 3.15 cts. Chicago: 2.95 to 3 cts. St. Louis: 2.9 to 2.95 cts.

NAILS.—Pittsburg: 85 cts. for wire, and 80 cts. for cut at mill in carload lots.

BARBED WIRE.—Pittsburg: galvanized, $1.85; plain, $1.15 to $1.20, for carloads at mill.

FOUNDRY AND PIG IRON.—New York: $10.00 to $12.50. Pittsburg: $10 to $10.65. Chicago: $9.50 to $10.50.

TRACK MATERIAL.—New York: angle bars, 1.25 to 1.4 cts.; spikes, 1.45 to 1.6 cts.; track bolts, 1.8 to 1.9 cts. with square, and 1.9 to 2 cts. with hexagon nuts. Chicago: angle bars, 1.3 to 1.35 cts.; spikes, 1.6 to 1.7 cts.; track bolts, 1.9 to 2 cts., with hexagon nuts.

RAILS.—New York: $22 at eastern mills and $22.75 at tidewater; old rails, $11.50 to $12 for iron, and $10 to $10.50 for steel; steel rails fit for relaying, $14.00; light rails, $21; girder rails, $24. Pittsburg: $22 for standard sections of 45 lbs. and over: $23 for light sections; old rails, $12 for iron and $9 to $11 for steel. Chicago: $23 for standard sections; $25 for light sections; old rails, $10 to $11 for iron, and $6.50 to $9 for steel.

STRUCTURAL MATERIAL.—New York: beams, 1.3 to 1.5 cts.; channels, 1.35 to 1.5 cts.; angles, 1.2 to 1.35 cts.; tees, 1.4 to 1.6 cts.; universal mill plates, 1.2 to 1.35 cts.; steel plates, 1.25 to 1.4 cts. for tank, 1.4 to 1.45 cts. for shell, 1.5 to 1.65 cts. for flange, 1.75 to 2 cts. for ordinary firebox, 2 to 2.25 cts. for locomotive firebox. Pittsburg: beams, 1.25 to 1.3 cts.; channels, 1.25 to 1.3 cts.; angles, 1.1 to 1.2 cts.; tees, 1.35 to 1.4 cts.; universal mill plates, 1.1 to 1.2 cts.; steel plates, 1.15 to 1.25 cts. for tank, 1.3 to 1.35 cts. for shell, 1.35 to 1.4 cts. for flange, 2.5 to 3.75 for ordinary firebox, and 3.35 to 3.5 cts. for locomotive firebox. Chicago: beams, 1.45 to 1.5 cts.; channels, 1.45 to 1.5 cts.; angles, 1.3 to 1.35 cts.; tees, 1.55 to 1.6 cts.; universal plates, 1.4 to 1.45 cts.; steel plates, 1.35 to 1.4 cts. for tank, 1.5 to 2 cts. for flange, 2 to 4.5 cts. for firebox.

INDUSTRIAL NOTES.

THE COTTON PALACE, at Waco, Tex., was burned Jan. 19, involving a loss of $75,000. It formed part of a winter exhibition.

THE CARNEGIE STEEL CO., of Pittsburg, Pa., is reported as contemplating the establishment of gun works on a large scale at its Homestead plant.

THE NIAGARA FALLS METAL SIGN CO., of Niagara Falls, N. Y., will establish a Canadian branch plant under the direction of Frank Le Blond, of Niagara Falls, Ont.

THE BLACKMER & POST SEWER PIPE CO., of St. Louis, Mo., has acquired control of the St. Louis Sewer Pipe Co., and the latter has now been consolidated with the former company.

THE CHICAGO SHIPBUILDING CO., of Chicago, Ill., has a contract for a steel steamer of 6,000 tons for a Duluth and Chicago company. It will be 405 ft. long, and will cost about $225,000.

A SUGAR REFINERY, at Camden, N. J., is proposed by Adolph Segat, the plant to cost $3,000,000 and to have a daily capacity of 4,000 barrels of refined sugar. Ground has already been secured.

THE IRONTON STRUCTURAL STEEL CO., of Duluth, Minn., will erect two open-hearth steel furnaces, owing to the difficulty experienced in securing the requisite blooms for rolling beams in the new mill.

THE HUNTER VALLEY STONE CO., of Bloomington, Ind., has been incorporated by W. W. Wicks, W. P. Rogers and William N. Showers, with a capital stock of $80,000, to quarry stone on 60 acres of land.

DUNBAR & SULLIVAN, of Cleveland, O., contractors for dredging, are building an iron dump scow at Sault Ste. Marie, Mich., and will spend $75,000 in renewing and rebuilding their outfit of dredges, tugs and scows.

THE EMPIRE CHAIN WORKS, of Philadelphia, Pa., owned by Bradlee & Co., have completed the chain cables for the new American Line steamers "St. Louis" and "St. Paul." There are 330 fathoms of 2¾-in. stud cable for each, weighing about 150,000 lbs.

THE NEW YORK POWDER CO., of 62 Liberty St., New York city, is introducing Black Diamond powder for coal mining, the new explosive being claimed to be flameless, three times as powerful as common powder, but slow-acting, so that it will not shatter like dynamite.

THE BUCYRUS STEAM SHOVEL & DREDGE CO., of South Milwaukee, Wis., has failed, and two receivers have been appointed by the court. The plant is said to be worth $200,000. It is hoped that an arrangement can be effected with the creditors under which the works will continue in operation.

THE INMAN BROS. CONSTRUCTION CO., of 136 Liberty St., New York city, has had David J. Lees appointed as its receiver, according to reports in the daily press. The company was incorporated in 1893 under the laws of New Jersey, with a capital stock of $125,000, succeeding the firm of Inman Bros.

THE PITTSBURG & GEORGIA LAND CO., of La Grange, Ga., has been incorporated to establish cotton mills, etc., at that place. Pres., F. M. Langley; Vice-Pres. and Gen. Man. James W. Drape, of Pittsburg, Pa.; Secy., W. J. McClure.

THE RUNYON SUSPENSION BRIDGE CO., of Kansas City, has been organized to manufacture bridges under the patents of E. G. Runyon and L. D. Cherry. Pres. and Gen. Man., Charles L. Lewis; Vice-Pres., L. S. Cherry; Ch. Engr., F. C. Florance.

THE WESTERN ASPHALT BLOCK & TILE WORKS, of New Castle, Pa., will be operated by the receiver, George W. Johnston, by permission of the court, as there is material on hand to make about 50,000 blocks, which C. N. Burchinal has offered to buy at $35.50 per 1,000.

THE WHITE LOCOMOTIVE CO., 15 Niagara St., Buffalo, N. Y., has recently been incorporated under the laws of West Virginia, and is said to have acquired the patents on the Raub locomotive. Vice-Pres., John L. White, Jamestown, N. Y.; Secy., Walter Scott, Buffalo, N. Y.

THE COLORADO FUEL & IRON CO., of Pueblo, Colo., made the following output during 1894: Pig iron, 70,961 tons; spiegel, 3,923 tons; castings, 3,109 tons; steel rails, 66,619 tons; spikes, 846 tons; merchant iron, 6,678 tons; steel angle bars, 844 tons; iron ore smelted, 156,997 tons.

THE MOLYNEUX ELECTRIC MFG. CO., of Buffalo, N. Y., has been incorporated by Frank Hammond and Barton S. Molyneux, of Buffalo, and H. Walter Webb and Edgar Van Etten, of New York city, with a capital stock of $30,000, to manufacture machines for engraving stamping dies, motor trucks for street cars, etc., under the Molyneux patents.

THE AMERICAN HOIST & DERRICK CO., of St. Paul, Minn., is building a 45-ton traveling boom derrick for the navy yard at Mare Island, Cal., to be used for handling and placing in position the armor plates on ships in the dock. The derrick will run on a track of 20-ft. gage along three sides of the dock.

THE NATIONAL SWITCH & SIGNAL CO., Easton, Pa., has recently received an order for interlocking the crossing of the Indiana, Illinois & Iowa R. R. with the Lake Shore & Michigan Southern R. R. at South Bend, Ind. The machine will consist of 14 working levers operating 6 switches, 6 F. P. locks and 10 signals.

THE GATES IRON WORKS, of Chicago, Ill., had its foundry department at Stein and Redfield Sts. destroyed by fire Jan. 25, involving a loss of $75,000 on the building, machinery and patterns. The buildings included a two-story brick engine room and pattern shop 50 × 100 ft. and a one-story frame blacksmith shop. The fire was started by an overturned stove in the engine room.

THE GEORGIA MINING, MFG. & INVESTMENT CO., of Atlanta, Ga., has had its property, valued at $3,000,000, placed in the hands of a receiver. The company controls the Dade Coal Co., Walker Iron & Coal Co., Georgia Iron & Coal Co., Chattanooga Iron Co., Barlow Iron & Manganese Co. and Castle Rock Coal Co., all operating coal and iron mines in north Georgia, near the Tennessee line.

THE ALLERTON LUBRICANT CO., of Chicago, Ill., has been incorporated with a capital stock of $3,000,000, to manufacture a lubricant composed of waste mica boiled in oil. The lubricant is in use for car axles, electric motors, etc., and it is said that it will not freeze, melt or gum. The selling agent is the Allerton-Clarke Co., of 83 Reade St., New York, and 23 Lake St., Chicago, Ill.

JAMES STEWART & CO., of St. Louis, Mo., and Buffalo, N. Y., have been awarded contracts for building the new Dwight mill at Alabama City, Ala. It will consist of a 4-story main mill building 500 × 100 ft.; boiler and engine room, 150 × 84 ft.; and two warehouses 75 × 100 and 100 × 300 ft., respectively. All are to be of brick, on stone foundations, of the heaviest style of mill construction. Work is to begin at once.

J. H. DOUSMAN, Matthews Building, Milwaukee, Wis., has recently received contracts for his automatic stand-pipe valves for Rock Island and Dundee, Ill., and Thomasville, Ga. He has recently put in one of his 10-in. valves at De Kalb, Ill., and has had one working on the stand-pipe at Batavia, Ill., since December, 1894. He is also putting on the market a regulator valve to be used in connection with his automatic cut-off valve.

THE UNITED STATES WIND ENGINE & PUMP CO., Batavia, Ill.—T. W. Snow, Asst. Gen'l Agent of this company, informs us that during 1894 it put in 21 complete systems for towns, besides a considerable amount of work for railways. It also designs and builds all kinds of windmill outfits. The company reports a number of contracts on hand for complete systems, work on which is to be commenced as soon as the frost leaves the ground.

THE UNION STEEL CO., of Alexandria, Ind., which was recently organized by a consolidation of other companies, as noted in our issue of Jan. 10, will, according to agreements made between these companies, remove to Alexandria the New Albany Rail Mill of New Albany, Ind., and the Bessemer steel works of the Valley Steel Co., at Belleville, Ill., consolidating the two and erecting them on a site of 50 acres donated by the Rolling Mill Land Co.

THE WELLMAN IRON & STEEL CO.'S plant at Chester, Pa., was sold Jan. 12 by the receiver for $900,000, which is $17,000 above the bonded indebtedness. The purchasers were J. Tatnall Lea, president of the First National Bank, of Philadelphia; Wm. Burnham, of the Baldwin Locomotive Works, and Wm. C. Neilson, a former manager of the Wellman mills, who represent a syndicate of creditors. The company is to be reorganized, and it is hoped to get the mills running in the course of two months.

THE CENTRAL SEWER PIPE CO., of Kansas City, Mo., has the contract for the sewer pipe required in the sewerage system of San Antonio, Tex., and it is said to be the largest single contract for such material ever placed in this country. The contract for constructing this system of sewers was awarded to J. B. Hindry, of Denver, Colo., as noted in our issue of Jan. 10, and he has 400 days to complete the work. The sale of pipe was made through A. H. Dickey, representing the company. Pres., Walter S. Dickey; Vice-Pres., Geo. C. Martin; Secy., L. W. McCallum.

THE JEFFERY MFG. CO., of Columbus, O., is bringing out a new electric locomotive for mining purposes, made in sizes of 40, 60 and 80 HP. It is mounted on four wheels, the frame resting upon coiled springs upon the axle boxes. The machine is about 10 ft. long and 5 ft. wide, stands 2 ft. 8 ins. above the rail, and weighs 19,000 lbs. Power is taken from an overhead wire by a trolley. One of these machines has hauled on a level 65 coal cars, each weighing 1,200 lbs. and carrying 3,000 lbs. of coal, the total load being about 136 tons, and the speed 8 miles per hour.

THE NEW COLUMBUS BRIDGE CO., of Columbus, O., reports to us that it is building two 164-ft. through Pratt truss spans, one 132-ft. through Pratt truss span and one 90-ft. through plate girder span, besides several short deck plate girder spans on the Belt Line Extension of the Toledo & Ohio Central R. R. These are all for single track, but have a heavy truss for future double track. The company also has contracts for the iron-work in a five story fireproof building at Columbus, O., and one 200-ft. span at Murphy, N. C., besides the usual run of smaller work. Ch. Engr., I. M. Wolverton.

NEW COMPANIES.—Tri-State Telephone & Telegraph Co., Cincinnati, O.; $250,000; M. S. Forbes, Michael Ryan and P. R. Budd.

Bainbridge Steam Ferry Co., Bainbridge, Pa.; $500; Treas., H. W. Depue.

Wilcox Gas Co., Ridgeway, Pa.; $15,000, commencing with $1,500; C. W. Speltigue.

Peerless Fence Machine Co., Americus, Kan.; $20,000; S. M. Bell, S. Raley and M. Toomey.

Crocker Elevator Co., Maroa, Ill.; $50,000; J. Crocker, Thomas Costello and George Conover.

Joliet Supply Co., Joliet, Ill.; $20,000; Wm. Douglas, Joseph E. Ralph and Charles W. Munn.

B. & C. Pump Mfg. Co., Wichita, Kan.; $1,000; J. N. Chapple, J. W. O'Neil and A. T. Buckridge.

Texas Car & Foundry Co., Texarkana, Tex.; $25,000; W. A. Kesey, Joseph Deutschman and G. Frank.

American Gas Fuel Co., Washington, Ill.; $4,000; A. H. Danforth, David Ross and Robert S. Randall.

Hersey Construction Co., Chicago, Ill.; $35,000; W. H. Clark, Howard M. Carter and J. F. Hutchinson.

Hickory Fuel & Light Co., West Hickory, Pa.; $10,000, commencing with $1,000; Treas., M. R. Hardenburg.

La Grange Brick Co., La Grange, Ga.; $5,000; Pres., J. G. Truitt; Vice-Pres., H. C. Butler; Secy., W. J. McClure.

Chicago Corundum Wheel Co., Chicago, Ill.; $20,000; Henry R. McClelland, M. A. Snider and Edward Weltman.

Lindner & Remig Mfg. Co., New York, N. Y.; $100,000; gas and electric fittings; P. W. Remig, Brooklyn, N. Y.

McCallum Mfg. Co., Chicago, Ill.; $1,000,000; heaters, purifiers, etc.; Daniel W. McCallum, M. A. McLaughlin and E. J. Eygman.

F. X. Muller & Co., Buffalo, N. Y.; $6,000; wood and iron-working machinery; Frank X. Muller, F. R. Radler and Peter Lang.

Watchung Gas Co., New Jersey; $200,000; Chas. R. Knapp and Frank H. Cole, Somerville, N. J.; Franklin Everhart, New York city.

Bond Steel Fence Post Co., Adrian, Mich.; $40,000; Pres., George W. Bond; Vice-Pres., David Metcalf; Gen. Man., A. M. Keeney.

Railway Gate Co., Buffalo, N. Y.; $9,000; crossing gates of the Wilson patent; Jacob K. Eckert, Robert C. Hickok and Loren F. Boles.

Guaranty Building Co., Buffalo, N. Y.; $500,000; to build a 13-story building at Pearl and Cloud Sts.; W. E. Hazard and Charles H. Keep.

New York & Westchester Gas Co., Pelham Manor, N. Y.; $100,000; A. A. Forman, Franklin B. Case, Jr., and Paul Graham, of Brooklyn, N. Y.

Frederick & McCabe Construction Co., Baltimore, Md.; $50,000; electrical work and power plants; Pres., Laurence N. Frederick; Man., Laurence P. McCabe; Cons. Engr., Frank H. Sloan.

Guest-Bates Marine Life Saving Appliance Co., Hoboken, N. J.; $100,000, commencing with $1,000; James A. Guest, 1620 Nineteenth St. N. W., Washington, D. C.; J. H. Bates, 321 Hudson St., Hoboken, N. J.

American Concrete Construction Co., Camden, N. J.; $10,000, commencing with $1,000; Nathan Snering, 1330 South 13th St.; Caspar W. Haines, 109 South 13th St.; Daniel F. Keenan, 868 Perkromen St., all of Philadelphia, Pa.